Globalisation Effect on Inflation in the Great Moderation Era: New Evidence from G10 Countries

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Abstract

The effect of globalisation on inflation is modelled and simulated for ten countries from G10 during the Great Moderation period. The results are supportive of the globalisation hypothesis. In particular, the results show that dynamic channels and magnitudes of globalisation to domestic inflation are highly heterogeneous from country to country, that increases in trade openness could be either inflationary or deflationary, while increased imports from low-cost emerging-market economies have been mostly deflationary, and that there has been almost no direct globalisation impact as far as inflation persistence is concerned while the impact on inflation variability can be positive as well as negative. Overall, globalisation is shown to have contributed positively to the aspect of low inflation rather than that of stable inflation during the Great Moderation era.

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1. Introduction

The effect of globalisation on inflation of the last two decades constitutes one of the unsettled issues in the recent debate over the state of macroeconomics in the wake of the latest global recession triggered by the 2008 financial crisis. It relates particularly to the discussion of whether the state of low and stable inflation in many developed economies of the West since the early 1990s, a period referred to as the 'Great Moderation' (see Bernanke, 2004), should be credited to the success of domestic macroeconomic policies or simply to the rising global supply of cheap manufactured goods from those rapidly developing economies such as China (see, eg McCarthy, 2007; White, 2008; Bean, 2010). Should globalisation be a major factor in driving domestic inflation, standard monetary theories of inflation could be invalidated, eg see Wang and Wen (2007).[1]

It is a well-known fact that there exists a considerable degree of correlation in the inflationary processes among many developed countries, as shown from Table 1 of the Western countries of G10. When it comes to econometric model results, however, the evidence is inconclusive concerning the hypothesis of whether globalisation has indeed significantly contributed to the inflation dynamics of these economies. For example, while supportive evidence are presented in Pain *et al* (2006, 2008), Borio and Filardo (2007), Pehnelt (2007), Wang and Wen (2007), and also partially in Ciccarelli and Mojon (2010), negative results are reported by Ball (2006) and Ihrig *et al* (2010).

The present investigation seeks to sharpen the evidence by improving, in two key respects, the empirical rigour of modelling the globalisation effects on inflation. First, domestic inflation is modelled at a country-by-country level with a careful choice of the variables representing globalisation. The LSE general-to-specific dynamic specification approach is adopted to ensure empirical robustness of the end model choice. The G10

[1] See also White (2009) for a more general critique.

economies except Japan form the objects of our investigation and quarterly data are used. Second, model simulations are carefully constructed to illustrate the globalisation effects. In particular, a novel simulation is designed to evaluate the disaggregate import effects from the low-cost emerging-market economies. The design overcomes a key weakness in the existing practice of macro model simulations – the lack of cross-country price level differences from the aggregate price indices.

In short, our modelling experiment has resulted in relatively robust inflation models for the most of ten economies during the Great Moderation period. In all the ten cases, the responsiveness of inflation to import prices has been statistically significant; and in eight out of the ten cases, foreign trade openness has been also found significant. Moreover, the model simulation results show that both the trade openness and rising imports from the emerging-market economies have exerted sizeable effects on the level and variability of inflation but that globalisation has impacted little as far as inflation persistence is concerned. On the whole, the evidence that we have produced is sufficiently strong to support the globalisation hypothesis.

The rest of the paper is organised as follows. The next section describes our modelling method and the related data issues; the subsequent section discusses our model simulation designs and the related data measurement issues; the empirical results concerning globalisation are discussed in section 4, which is followed by a short section summarising the main findings.

2. Modelling strategy and data issues

Most of the existing empirical studies are based on extended Phillips curve models, eg Ball (2006), Borio and Filardo (2007), Pehnelt (2007), Ihrig *et al* (2010), Guerrieri *et al* (2010) and Mihailov *et al* (2011). One theoretical weakness of the type of Phillips curve models is the absence of explicitly specified long-run disequilibrium effect on the inflation dynamics. The long-run effect is included in the form of an error-correction term in the models by Pain *et al* (2006, 2008). We shall follow their step. Analyses based on common factor models have also become popular, eg see Ciccarelli and Mojon (2010). However, common factor models or correlation-based analyses do not separately identify the effects of domestic versus foreign factors, whereas the separation is crucial in our present country-specific investigations. It is, nevertheless, interesting to note that Ciccarelli and Mojon have employed an error-correction mechanism to relate domestic inflation rates to global inflation.

The issue of how to represent globalisation in models is arguably the most crucial here. Various channels of globalisation has been discussed in the literature, such as import price path-through, global output slacks, global competition via labour and capital markets. However, it is evident from numerous empirical studies that the globalisation effect on domestic inflation is mainly through overseas goods market imbalance or disequilibrium. Four variables are usually used to capture such imbalance – foreign output gaps, trade openness indicators, import price and common factors from cross-country inflation series. We shall adopt only two here – import price and trade openness indicators. Foreign output gaps are disregarded on both theoretical and empirical considerations. Theoretically, our aim is to model how much inflation of a specific country is affected by foreign markets, rather than how much global inflation is affected by global market supply and demanding conditions. Therefore, prices from abroad should contain adequate and timely information on the global market conditions. Empirically, data on foreign output gaps are not directly collected but indirectly derived. The derivation lacks a unanimously accepted formula; and the available modelling evidence using the data is disappointing, eg see Calza (2009) and Ihrig *et al* (2010), owing possibly to rather high degrees of measurement errors involved in the derivation. Global inflation is derived from common factor models in Mumtaz and Surico (2008), and also Ciccarelli and Mojon (2010). The latter study further uses the common factor as a leading indicator to predict inflation of each country in a panel of twenty-two developed economies. While latent common factors do capture certain amount of the global inflationary effect, the method suffers from two shortcomings – limited sample representation of global inflation through exclusion of mainly the majority of developing economies in panels from which the factors are derived, and failure to exclude the inflation data of each economy to be modelled from the common factor, making it difficult to identify the factor as purely a foreign price variable.

We thus start the modelling experiment with import price since it is the least controversial and the most commonly used variable to capture the foreign trade effect.[2] Denoting P_{it} as the aggregate price index, p_{it} its logarithm and Δp_{it} as inflation for country *i* under study, we take the following general form of an error-correction model:

$$\Delta p_{it} = \alpha_{i0} + \sum_{j=1}^{n} \alpha_{ij} \Delta p_{it-j} + \sum_{j=0}^{n} \lambda_{ij} \Delta w_{it-j} + \sum_{j=1}^{n} \delta_{ij} u_{it-j} + \sum_{j=1}^{n} \varphi_{ij} y_{it-j}^{G}$$
(1)
$$+ \sum_{j=0}^{n} \beta_{ij} \Delta p_{it-j}^{M} + \gamma_i ec_{it-1} + \varepsilon_{it}, \qquad ec_t = p_{it} - \kappa_{i1} w_{it} - \kappa_{i2} p_{it}^{M}$$

where w_{it} is the logarithm of wage index, W_{it}, p_{it}^{M} the logarithm of the import price index, P_{it}^{M}, y_{it}^{G} the domestic output gap, and u_{it} the unemployment rate. The wage index is used as a proxy of domestic costs, eg see Pain *et al* (2006, 2008). Obviously, it is impossible to rule out any foreign impact on wages, as pointed out by Ihrig et al (2010). However, simple correlation analyses show that the degree of correlation in cross-country wage rates is notably smaller than that of inflation on average, eg see Table 2 versus Table 1. It should be noted that (1) resembles an extension of typical augmented Phillips

[2] In fact, Pain *et al* (2008) conclude that the indirect effect through import prices seems to be the only channel through which foreign economic conditions affect consumer price inflation.

curve models by an ec_{it-1} term. Here, model (1) also generalises model [A1.1] in Pain *et al* (2006) in three aspects: (a) It does not impose static homogeneity in the ec_{it-1} term; (b) it allows for more than one lag of y_{it}^{G}; and (c) it considers u_{it} since it was a key variable in the original Phillips' curve prior to the invention of y_{it}^{G} and since empirical evidence of the role of y_{it}^{G} has not been unquestionably strong. However, model (1) excludes certain variables, such as energy and food price inflation, which have been considered in the literature, eg see Borio and Filardo (2007) and Ihrig *et al* (2010). The exclusion is based on the observation that inflation series of these prices tend to be considerably correlated with those of import prices, as shown in Table 3. The correlation makes it incoherent not to interpret the significance of the food and energy price inflation variables as evidence of globalisation.

Obviously, β_{ij} and κ_{i2} in (1) form our parameters of interest here and evidence of $\beta_{ij} \neq 0$ and/or $\kappa_{i2} > 0$ is confirmatory of the globalisation hypothesis. However, a more interesting and specific facet of the hypothesis is that the impact of p_{it}^{M} could increase with the growth of trade while the roles of those domestic factors decrease. Many existing studies test the facet by comparison of sub-sample estimation results, which basically follows the time-varying parameter approach. Unfortunately, the approach suffers from the drawback of neglecting the possibility of time-varying parameter estimates being the result of model mis-specification. It also makes it difficult to further apply models for simulation or projection purposes. Hence, we intend to try and obtain constant-parameter models by isolating the effect of trade intensification through appropriate variable choice. Besides, the limit of our attention to the Great Moderation era should help reduce the risk of significant parameter shifts. Specifically, we postulate an alternative model to (1) by introducing a trade-ratio based openness index, r_{it}^{O}, as a measure of increasing import penetration, similar to what Pain *et al* (2006, 2008) and Ihrig *et al* (2010) have done:

(2)
$$\Delta p_{it} = \alpha_{i0} + \sum_{j=1}^{n} \alpha_{ij} \Delta p_{it-j} + \sum_{j=0}^{n} \lambda_{ij} \Delta \widetilde{w}_{it-j} + \sum_{j=1}^{n} \delta_{ij} \widetilde{u}_{it-j} + \sum_{j=1}^{n} \varphi_{ij} \widetilde{y}^{G}_{it-j} + \sum_{j=0}^{n} \beta_{ij} \Delta \widetilde{p}^{M}_{it-j} + \gamma_i ec_{it-1} + \varepsilon_{it}, \qquad ec_t = p_{it} - \kappa_{i1} \widetilde{w}_{it} - \kappa_{i2} \widetilde{p}^{M}_{it}$$

where weighted variables are denoted by circumflex. For example, $\widetilde{y}^{G}_{it} = y^{G}_{it}\left(1 - r^{O}_{it}\right)$. Noticeably, W_{it} and P^{M}_{it} can be weighted by either arithmetic weight or geometric weight. The former is adopted here, ie $\widetilde{p}^{M}_{it} = \ln\left(P^{M}_{it} r^{O}_{it}\right)$ and $\widetilde{w}_{it} = \ln\left(W_{it}\left(1 - r^{O}_{it}\right)\right)$, after experimenting with both.[3] Other variations of (2) should also be possible depending on which parameters in (1) are potentially most susceptible to trade-induced shifts. For example, Pain *et al* (2006, 2008) only consider the case of weighted long-run parameters, ie:

(2a)
$$\Delta p_{it} = \alpha_{i0} + \sum_{j=1}^{n} \alpha_{ij} \Delta p_{it-j} + \sum_{j=0}^{n} \lambda_{ij} \Delta w_{it-j} + \sum_{j=1}^{n} \delta_{ij} u_{it-j} + \sum_{j=1}^{n} \varphi_{ij} y^{G}_{it-j} + \sum_{j=0}^{n} \beta_{ij} \Delta p^{M}_{it-j} + \gamma_i ec_{it-1} + \varepsilon_{it}, \qquad ec_t = p_{it} - \kappa_{i1} \widetilde{w}_{it} - \kappa_{i2} \widetilde{p}^{M}_{it} \; ;$$

Ihrig *et al* (2010) experiment with adding weighted $\widetilde{y}^{G}_{it}$ and $\widetilde{p}^{M}_{it}$ to an augmented Phillips curve models rather than replace the relevant un-weighted variables (their model does not have the error-correction term). We shall experiment with several variations of model (2) with different mixture of weighted explanatory variables, for example, one with only the short-run variables weighted and another with only the long-run variables weighted.

Many existing studies adopt simply the *a priori* dynamically specified inflation models, for example those which follow the New Keynesian theoretical approach. We believe it mainly an a posteriori matter to appropriately specify the dynamic structure of a

[3] We find models with geometric weighted variables usually result in larger residuals and much worse simulation results than models with arithmetic weighted variables.

model, especially its short-run structural part, see Hendry and Richard (1982, 1983), Hendry *et al* (1984). In order to search for empirically robust model specifications, especially in the present case where we face multiple possible model variations, it is essential to put in place a set of criteria for model choice. The criteria that we adopt are based on the LSE general-to-specific model specification approach, see Hendry (1995). Specifically, model reduction via 'testimation' by the general-to-specific approach is carried out for (1) and several variations of (2). The resulting simplified models are assessed especially for having (a) correct signs of the long-run parameters and the negative feedback parameter of the ec_{it-1} term, and (b) relatively constant parameter estimates, in addition of passing all the commonly used diagnostic tests. When more than one such data-coherent model is found for one country, encompassing tests are performed to assist the end model selection.

The above modelling strategy is applied to ten countries of the G10: Belgium (BEL), Canada (CAN), France (FRA), Germany (DEU), Italy (ITA), Netherlands (NLD), Sweden (SWE), Switzerland (CHE), the UK and the US. Japan is left out here because of its post-1990 idiosyncratic experience of deflationary recession, eg see McKinnon and Ohno (2001). Quarterly data is collected for the period 1985-2010. Annual inflation, the modelled variable Δp_{it}, is calculated from CPI series in line with most of the existing studies. We shall skip a general description of the inflation dynamics since the late 1980s up to the recent global recession, because that has been adequately covered in various recent studies, such as IMF (2006), Melick and Galati (2006), Pain *et al* (2006, 2008), White (2008) and Bean (2010). The only aspect that we want to emphasise here is that there is a visible increase of cross-country correlations in inflation since the late 1990s (see Table 1), especially compared to the cross-country wage rate correlations shown in

Table 2, and that the increase is coupled with an increase in the cross-country import prices, as shown from Table 3.

There are mainly three ways of defining the openness index: the ratio of imports to GDP, the ratio of imports to GDP plus imports and the ratio of imports plus exports to GDP plus imports.[4] We have tried all three and found from our sample calculation that the three carry virtually identical trends with 99% correlation on average. We shall adopt the ratio of imports to GDP plus imports as the openness index here for its relative closeness to representing import penetration. Figure 1 shows the ten openness series (the solid curves), and a rising trend is discernable from the figure of all the countries except for Canada prior to the 2008 recession, although the degrees of openness differ a great deal across the ten economies, with Belgium and the Netherlands enjoying relatively high degrees while the US remaining at a very low degree. Detailed definitions and sources of the other explanatory variables in (1) and (2) are given in the appendix.

Overall constancy of parameter estimates is one of our top concerns. Significant shifts of parameter estimates are reported in several of the existing studies. In particular, a significant shift is reported in the inflation process of the OECD countries in the mid 1990s in Pain *et al* (2006, 2008). To detect such shifts, recursive estimation and sequential Chow tests are employed in our initial modelling experiment using the data sample of 1985-2010. The experiment has indeed revealed significantly shifting parameter estimates during the early part of the sample. To verify that the shifts are not just the symptom of initially small subsamples of the recursive estimation procedure, a sequence of general-to-specific model reduction experiments is carried out, each with a decreased sample by one year from 1985. The experiments show that severe model fluctuations have receded once the sample is reduced to 1992-2010. Although our focal

[4] The KOF index of globalization compiled by Swiss Economic Institute is used to represent openness in Pehnelt (2007). However, the index is only in annual frequency and the series exhibit less variation than the three indicators discussed here.

concern is the globalisation effect on inflation during the Great Moderation era, we have kept the post-2008 observations mainly for the purpose of examining parameter constancy. Italy is the only economy which exhibits certain visible parameter shift in 1995 from recursive estimation. Our finding suggests that much of the model fluctuations is probably due to the economic downturn in the West from the late 1980s to the early 1990s, and the finding also confirms to Bean's (2009) demonstration of the post-1992 period being the 'Great Moderation' era. Henceforth, we set the data sample to 1992-2010 for our main modelling exercise.

Panel or pooled-sample estimation is commonly used in the existing studies. Such exercise actually imposes identical key parameters and homogeneous model format. To assess the validity of those imposed assumptions, we conduct general-to-specific model reduction on individual countries first before considering the possibility of applying the panel method. It turns out through our extensive model reduction exercise that both the model form and parameter estimates vary so considerably across the ten economies, including those long-run static parameter estimates, that there lacks adequate basis to impose identity on key parameters of interest with panel, pooled-sample or system-of-equations estimation. Table 4 reports the key regression results from the model reduction exercise. The model versions given in the table are only those which have passed various diagnostic and encompassing tests. Most of those routine test results are omitted from the table due to lack of space. The parameter estimates in bold indicate that the corresponding variables are weighted by the openness index, and therefore the corresponding model version is a variation of model (2). It should be noted that UK is the only country where two versions are reported, one from (1) and the other from (2), as encompassing tests fail to indicate which one outperforms the other.[5] Notice also that long-run static homogeneity does not hold for all countries.

3. Model simulation design and data measurement issues

Successful search for data-coherent models will not only help shed light on why some of the previous empirical studies have resulted so diverse findings, but also enable us to conduct counterfactual model simulations to illustrate how much globalisation has affected domestic inflation. Such illustrations will facilitate quantitative assessments of the dynamic impact of particular driving variables of interest which are otherwise difficult to achieve directly from the estimated models.

The common route of simulating the globalisation effects is via counterfactual shocks of certain external price series. For example, a decrease in the import price variable by a fixed percentage or a decrease of a major component of the import price such as the oil price or the commodity price index, eg see IMF (2006) and Pain *et al* (2006, 2008). However, it is impossible to quantitatively evaluate from those simulations to what extent the increasing imports from the relatively low-cost emerging market has affected inflation in the developed economies. Nickell (2005) and Pain *et al* (2006, Box 1) propose to evaluate the impact of imports from a certain group of countries by making use of the individual foreign price and trade weight components of the import price variable of a country under study. However, neither study has actually carried out a simulation along this line to illustrate the import impact from the emerging markets.

Here, we shall extend their proposed method to try and design simulations which will illustrate quantitatively how much the low inflation episode in the 'Great Moderation' era was related to the relatively low priced goods imported from the

[5] Note that the long-run relation is identical for both models (1) and (2) in the UK case.

emerging markets. To that end, we first construct an import price series for each country using the export prices of most of the trading partners to country *i*:

$$\text{(3)} \qquad \hat{P}_{it}^{M} = \exp\left\{\sum_{j=1}^{N} w_{jt}\, p_{jt}^{X}\right\}_{i}$$

where p_{jt}^{X} denotes the US dollar denominated export prices in logarithm of those foreign countries trading with country i and w_{jt} their trading weights. We aim at having the constructed price series in (3), when converted into the domestic currency, approximate well of P_{it}^{M}, ie $\hat{P}_{it}^{M} \approx P_{it}^{M}$. Next, we exploit (3) to decompose the set of trading partners into two groups: one for the emerging-market economies, $j \in E$, and the rest the developed countries, $i \in D$, with $D \cup E = N; D \cap E = 0$:

$$\text{(4)} \qquad \begin{aligned} \ln\left(P_{ht}^{M}\right) &= \left(\sum\nolimits_{i\in D} w_{it}\right)\sum\nolimits_{i\in D}\frac{w_{it}}{\sum\nolimits_{i\in D} w_{it}}\ln\left(P_{it}^{X}\right) + \left(\sum\nolimits_{j\in E} w_{jt}\right)\sum\nolimits_{j\in E}\frac{w_{jt}}{\sum\nolimits_{j\in E} w_{jt}}\ln\left(P_{jt}^{X}\right) \\ &= \left(1 - W_{Et}\right)\Pi_{Dt} + W_{Et}\Pi_{Et} \end{aligned}$$

The decomposition will enable us to carry out counterfactual simulations through fixing the values of W_{Et} and Π_{Et} respectively to evaluate the direct impact of imports from the emerging-market economies.

Thirty-two economies are included in the trade set for the calculated import prices by equation (3) (see the appendix for the list and data sources). In addition to the eleven countries of the G10, the rest economies are selected because of their relatively high ranks in import shares of the ten G10 countries to be modelled according to the Direction of Trade data released by the IMF. These include Algeria, Austria, Brazil, Belgium, the Czech Republic, China, France, Finland, Germany, Hungary, Ireland, Italy, Libya, Malaysia, Mexico, the Netherlands, Poland, Portugal, Russia, Saudi Arabia, Spain, Turkey, Canada, Hong Kong, Denmark, Japan, Norway, Sweden, Switzerland, United Kingdom, United States and Taiwan. The trade set covers about 80% of the total imports for each of the G10 country on average. The closeness of these calculated import price series to the published import prices are shown in Figure 2. To further decompose the calculated prices by (4), the trade set is divided into two subsets, with the developed economy set comprising the G10 plus Austria, Denmark, Finland, Ireland, Luxembourg, Norway, Portugal and Spain, and the rest forming the emerging-market set.

Now, a major problem arises when it comes to the decomposition equation (4): all the individual country export price indices are based on 2005=100, which effectively removes the differences in the aggregate price levels between the developed economies and the emerging-market economies. In other words, aggregate price indices reflect no information on the purchasing power parity (PPP) between countries by definition. To circumvent the problem, we make use of the PPP conversion factors for the year 2005 estimated by the World Bank (2008, Table 1.a) for around 150 countries. We are aware of the imprecise nature of using the World Bank factors here as these factors are estimated on the basis of both the service and goods prices of the domestic economies concerned while the price indices that we intend to convert are export prices only. But these factors are the best available aggregate ones and it is not unrealistic to assume that the export price level of an economy should be at par with its domestic price level in general. From a cross-section sample perspective, the World Bank estimates can be regarded as providing a set of PPP-based weights on the cross section of year 2005, whereas the panel of aggregate price indices which have been used in the calculated price series assume equal weights for all economies in 2005. Provided that the sample of 32 economies in our panel is adequately representative of the World Bank sample, recalculation of the price series by reweighting the individual price series using the World Bank PPP-based factors should not generate substantial differences from the result using the un-weighted ones.[6] Figure 3 illustrates the decomposed series of Π_{Et} and Π_{Dt} calculated by using the World Bank PPP-based factors to reweight all the export price series of the emerging-market economies in our trade subset. Noticeably, the gaps between the two sets of series are as wide as 50 on average.

Since for a few emerging market economies, the earliest available trade data start in 1994. Our counterfactual simulations are run for the period of 1994Q1 to 2008Q3, ie the main part of the Great Moderation era prior to the latest global recession. We begin by running a baseline simulation in which we substitute the actual series of the import price indices by those series constructed by (3).[7] This is to separate the errors owing to the deviations of the calculated indices from the actual indices out of the subsequent simulations. Next, three scenarios are designed to illustrate the globalisation impacts of three factors respectively: (i) the openness index by setting r_{it}^{O} fixed to its initial value at the beginning of the simulation, (ii) the trade shares by setting W_{Et} to its initial value at the beginning of the simulation and (iii) the disaggregate import prices by setting $\Pi_{Et} = \Pi_{Dt}$. Figures 4-6 and Table 5 summarises the simulated results.

A word of caution is necessary here before we move on to the next section. Simulations are limited by the models on which they are based. Here, the formulation of models (1) and (2) restricts our simulations at least in two respects. First, the indirect impact of import prices via labour costs, productivity gains through competition and other channels is beyond our simulations; second, the aggregate and dynamic features of the models make it impossible to separate out the individual contributions of Π_{Et} versus Π_{Dt} entirely.

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[6] The recalculation is tried for several of the G10 countries and the results show that the un-weighted and the weighted series are indeed very close.

[7] Our baseline simulation is in fact very close to the actual CPI series because of both the small residuals in our estimated equations and the relatively good fit of our calculated import price series to the actual ones (see Figure 2).

4. Empirical results of globalisation effects

We are now in the position of discussing the globalisation effects found from the econometric exercise. First, let us examine the relevant parameter estimates in Table 4. It is remarkable that all the countries except Sweden and the US fit in with model (2). Of the import price variable, the effects are of the globalisation-intensified type, ie the openness-index weighted type for six out of the ten countries in terms of the short-run variable and for six to seven of them in terms of the long-run variable. Moreover, unemployment variable is found to be the openness-index weighted type in the cases of Belgium, Italy and the Netherlands; the domestic output gap variable is found to be the openness-index weighted type in the cases of Italy and the UK; and the short-run wage rate variable falls also into the type in the cases of Canada, France, the Netherlands and Switzerland. If we focus ourselves on the import price variable irrespective of the openness index specification, we find that the long-run import price effect is present in all but the Italian models, and that the effect is stronger than that of the wage variable in Germany, the Netherlands, Sweden and Switzerland. A closer examination reveals that these four countries share the common features of both having their openness indices well above 30% and their shares of import from the emerging-market economies greater than 15% (see Figure 1). To a certain extent, the short-run import price effect is more striking. It is not only present in all the ten cases but also dominantly positive, with virtually an accelerative effect for more than half of the cases (ie close to the specification of $\Delta\Delta p^{M}{}_{t-j}$ with a positive coefficient). Hence on grounds of model (1), the evidence constitutes an over overwhelming case for the globalisation hypothesis. Even if on grounds of (2), the case is adequately strong.

Our results on the role of import price are in broad agreement with those reported in Pain *et al* (2006, 2008), although our long-run parameter estimates show too distinct heterogeneity to support their grouped estimates or assumed homogeneity. Nevertheless, it is clear from Table 4 that omission of the long-run effect is a model specification error in those studies which only consider short-run Phillips curve inflation models. It is also clear from the table that the lag structures of the short-run variables are more complicated and heterogeneous than what have been assumed in most of the previous empirical studies.

Let us now look at the simulation results given in Figures 4-6 and Table 5. Figure 4 shows how inflation would have differed from the baseline inflation if the trade openness had remained unchanged at the 1994Q1 level, $r_{it}^{O} = r_{i1994Q1}^{O}$. There are only eight series in Figure 4, since the Swedish and the US models are the simple type without the openness effect, as shown from Table 4. It is discernible from Figure 4 as well as Table 5 that the impact of the openness variable, r_{it}^{O}, on inflation vary considerably from country to country, except for inflation persistence where there the impact is negligible (see Table 5), and that increases in openness have a deflationary impact for Italy, a negligible impact for the UK, a fluctuating impact for France, Belgium and Canada and a relatively strong inflationary impact for Germany, the Netherlands and Switzerland. As mentioned above, Germany, the Netherlands and Switzerland share the features of having the long-run import price parameters larger than the wage parameters and of being more open to the emerging market economies. The simulated inflationary impact by openness can be interpreted as reflecting the fact that inflation rates have been generally higher in the emerging market economies than the developed countries. On the whole, it is difficult to generalise the directional impact of the degrees of trade openness on inflation in terms of both its level and its variability.

In comparison, it is easy to conclude a generally deflationary impact on inflation of the rising shares of imports from the emerging market economies. As seen from Figure 5 and also Table 5, holding the import shares constant at the 1994Q1 level would result in higher inflation, with the maximum impact found for the US (1.4 percentage point), the Netherlands (1.2 percentage point) and Germany (0.3 percentage point). Although generally small and different across the ten countries (ranging from 0.04 to 1.4 percentage point), the simulated result illustrates clearly that increasing imports from the emerging market economies have led to lower inflation in general. However, it is unclear if the imports have led to more stable inflation, as shown in Table 5.

It is natural to relate the deflationary impact of the increasing imports to the relatively cheap products by the emerging market economies. Such a price impact is examined in the next scenario. As clearly seen from Figure 6 and Table 5, realignment of the price levels of the emerging market economies to those of the developed countries would cause higher inflation in general and the impact is somewhat stronger than that of the previous scenario, although it remains unclear if the lower prices have led to more stable inflation. Again, the US, the Netherlands and Germany are the countries which demonstrate relatively the largest deflationary impact. Similar to scenario 1, there is little overall effects on inflation persistence of scenarios 2 and 3 concerning the disaggregate effects by the emerging-market economies.

Let us now look at the simulation results country by country. In the Belgium case, openness had an inflationary impact during 1994-2001 and 2004-2007, but a deflationary impact during 2001-2004 (see Figure 4). The overall impact is inflationary and also variability enhancing, as shown in Table 5. The impact of the share of imports from the emerging market economies is deflationary and very small, with a maximum of 0.04 percentage point (see Figure 5) or less than 1% difference from the baseline level (see Table 5). The impact of the import prices from the emerging market economies is also deflationary and small, with a maximum of 0.07 percentage point (see Figure 6) or less than 2% difference from the baseline level (see Table 5). The effects of these two scenarios on both inflation variability and persistence are negligibly small.

In the case of Canada, the openness index had a deflationary impact before 2002, and turned to inflationary thereafter, and the switch is most noticeable from Table 5, where it is seen to have concurred with a switching impact on the variability. The effects of the next two scenarios resemble the case of Belgium, only with larger magnitudes, as shown in Table 5. It is also interesting to note that imports from the emerging market economies have exerted an overall stabilising effect as far as the inflation variability of the full period is concerned.

The openness impact in the French case is almost the opposite of the Canadian case. The impact was mostly positive before the year of 2002, became significantly negative during 2002-2004, and returned to positive thereafter (see Figure 4). A notable feature of this scenario is the large stabilising effect on the inflation variability, as seen from Table 5. The deflationary impact of both the share and the price of imports from the emerging market economies here resembles the previous two cases, with the exception of the period of 1995-1999, where the price impact was considerably bigger.

Germany tops the group when it comes to the openness impact and the impact is notably inflationary, above 60% of the baseline rates on average (see Figure 4 and Table 5). Again, the deflationary impact of the next two scenarios in the present case is similar to the previous cases, only with much larger magnitudes. The impact of the import prices from emerging market economies on German inflation is over 30% of the baseline rates (see Table 5). It is, however, difficult to judge from the inflation variability statistics if the impact has been stabilising inflation.

Italy poses an opposite case to Germany in the openness scenario. The openness variable has shown clearly a deflationary and stabilising impact on the Italian inflation, with the maximum difference of 1.3 percentage point (see Figure 4) or above 20% of the baseline rates (see Table 5). However, the impact of scenarios 2 is found to remain extremely small and negative (see Figure 5 and Table 5). The impact of scenario 3 is slightly bigger and turns from inflationary to deflationary around 1997 (see Figure 6). There is some evidence that both scenarios have helped stabilising inflation (see Table 5).

The case of the Netherlands is similar to that of Germany as far as the inflation rates are concerned (see Table 5). In the openness scenario, the impact remains largely inflationary, except for the period 2002-2004 (see Figure 4). In scenarios 2 and 3, the deflationary impacts remain visibly strong, especially in the latter scenario, with the impact remaining above 1 percentage point since the late 1990s and exceeding 1.5 percentage point in 2006 (see Figure 6). The only noted difference from the German case is the inflation stabilising effect of the first scenario (see Table 5).

The openness scenario does not apply to Sweden because its end model form through model reduction is equation (1). The impact of both the share of imports and import prices from emerging market economies is clearly deflationary, about 20% of the baseline rates as shown in Figures 5 and 6 as well as Table 5. However, the impact is found not to be inflation stabilising (see Table 5).

Switzerland is another case which resembles that of Germany, only at a smaller scale. The impact of the openness variable is both inflationary and variability enhancing (see Figure 4 and Table 5), while the impacts of scenarios 2 and 3 are deflationary and stabilising (see Figures 5 and 6 and Table 5).

In the UK case, the openness impact is hardly visible from Figure 4, though it has remained above 2% on the inflationary side with a small stabilising effect (see Table 5). Again, the impacts in scenarios 2 and 3 are clearly deflationary, with negligible effect on the inflation variability, but not quite inflation stabilising.

The US is another case where the openness scenario is not applicable. Here, it is noticeable from Figure 1 that the openness index of the US remains exceptionally low (around 14% on average) as compared to the other nine countries. On the other hand, the US enjoys the highest and also fastest growth of the share of imports from the emerging market economies (see the dotted line in Figure 1). That helps to explain our simulation results from scenarios 2 and 3, which turn out to be both substantially deflationary and inflation stabilising (see Figures 5 and 6 and Table 5). The maximum deflationary impact of scenario 2 reaches 1.4 percentage point, while that of scenario 3 exceeds 1.5 percentage point. It is particularly noticeable from Table 5 that relatively low import prices from the emerging market economies have helped to reduce the inflation variability by over 25%, the largest of all the ten cases.

5. Concluding remarks

The econometric exercise has yielded strong and relatively robust evidence of globalisation on domestic inflation of ten countries from G10. The evidence is shown in terms of both significant coefficient estimates corresponding to variables representing globalisation effects and also model simulation results.

Among the relevant variables, import price has been verified as a key variable. In the majority of the ten cases, this variable is found to exert an increasing impact through a joint effect with an openness index in the long run and also a roughly accelerative effect in the short run. However, our country-by-country model search shows that dynamic channels and magnitudes of globalisation to domestic inflation are highly heterogeneous, making it questionable the suitability of evaluating the impact of globalisation by panel models or *a priori* tightly parameterised models.

The heterogeneity is probably most noticeable from the trade openness channel. The openness variable drops out from the model reduction in two (Sweden and the US) out of the ten cases and its presence in the rest cases takes a variety of forms. Model simulation by controlling the openness variable illustrates that its impact could be either inflationary or deflationary in terms of the level of inflation as well as either aggravating or alleviating in terms of inflation variability. The result supports White's (2008) conclusion that globalisation could result in episodes of low and stable domestic inflation as equally well as episodes of rising and more volatile inflation.

What we find more homogeneous from the simulation results are (i) the lack of globalisation impact on inflation persistence and (ii) a generally deflationary impact owing to imports from low-cost emerging market economies. However, there is some evidence that the deflationary impact has been gradually diminishing and that its associated impact on mitigating inflation variability has been weakening. The finding indicates that the rising supply of cheap goods from low-cost emerging market economies has indeed made non-negligible contribution to the state of low inflation in the advanced economies, but that the benefit does not extend to the state of stable inflation during the Great Moderation era.

Appendix *Data sources and derivation*:

CPI: 2005=100, IFS (International Financial Statistics, IMF), except for Germany where the data come from the OECD Main Economic Indicators database; annual inflation is calculated from these CPI quarterly series.

Nominal unit labour cost: IFS except for Switzerland where the data come from the OECD Main Economic Indicators database.

Output gap: Deviation of actual GDP from potential GDP as percentage of potential GDP; Quarterly data from Datastream except for Belgium and Switzerland where the data are annual from Datastream interpolated into quarterly ones by the authors.

Import price index: national currency, derived from converting US$ import price index (2005=100) by the appropriate exchange rate; all series from IFS except for France where the data is from CEIC database (http://www.ceicdata.com/).

Export price index in US$: 2005=100; IFS except for China, the Czech Republic, France, Libya, Russia and Taiwan; the data for the Czech Republic, Libya and Russia are from Datastream, the data for France (export deflator) and Taiwan are from CEIC, and the data for China are from He (2010). Those data originally not in US$ are first converted into US$ via exchange rate and then rebased to 2005=100.

Imports, exports and the GDP: national currency, from IFS.

Exchange rates: national currency/US$, from IFS, period average.

Trade shares: Calculated from DOT (Direction of Trade, IMF).

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Figure 1. The openness index, r_{it}^{O} (solid line) and the share of import from emerging market economies, W_{Et} (dotted line)

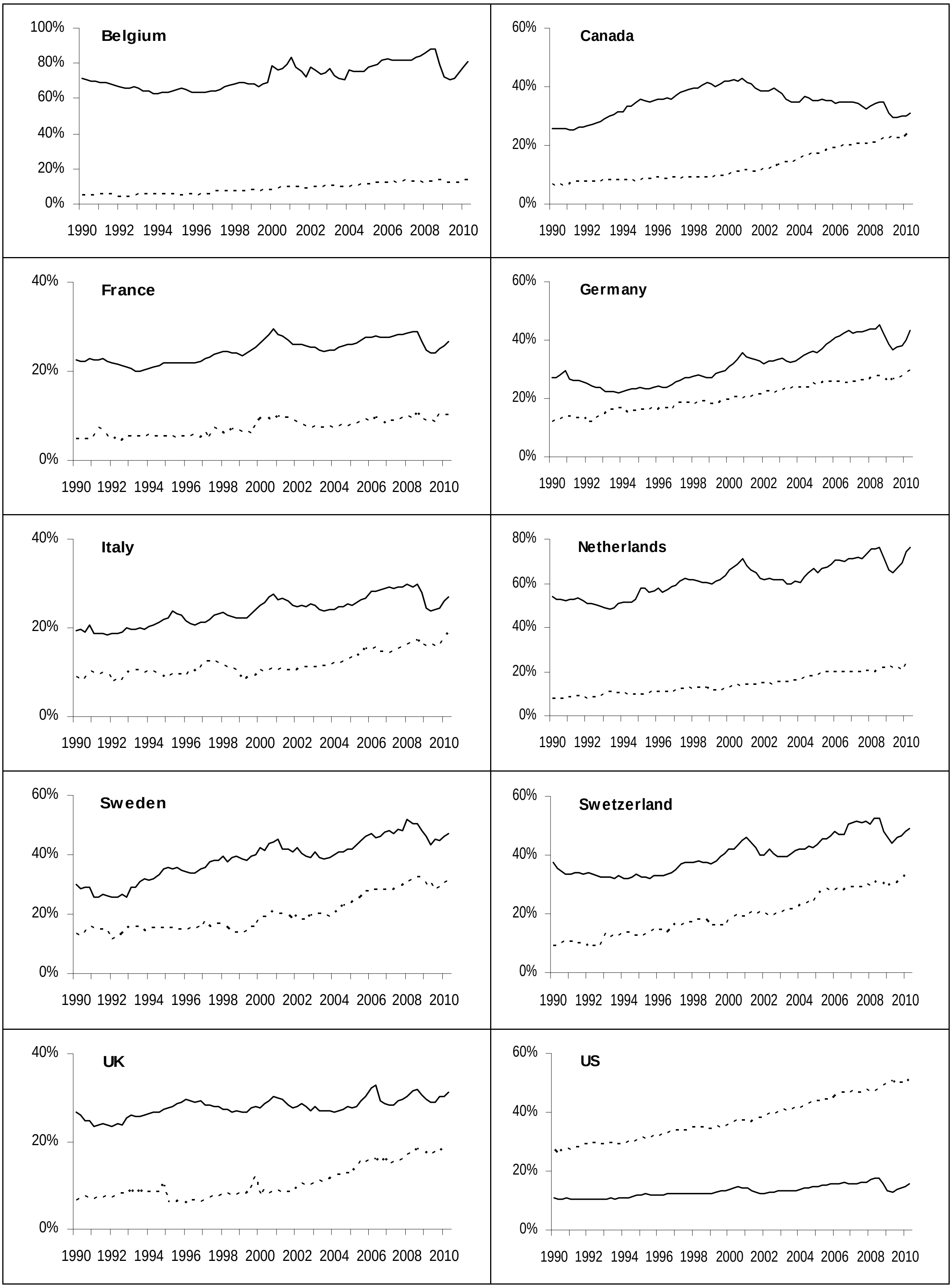


Figure 2. Actual import price, P_{it}^{M} (solid line) and Calculated import price, $\hat{P}_{it}^{M}$ (dotted line)

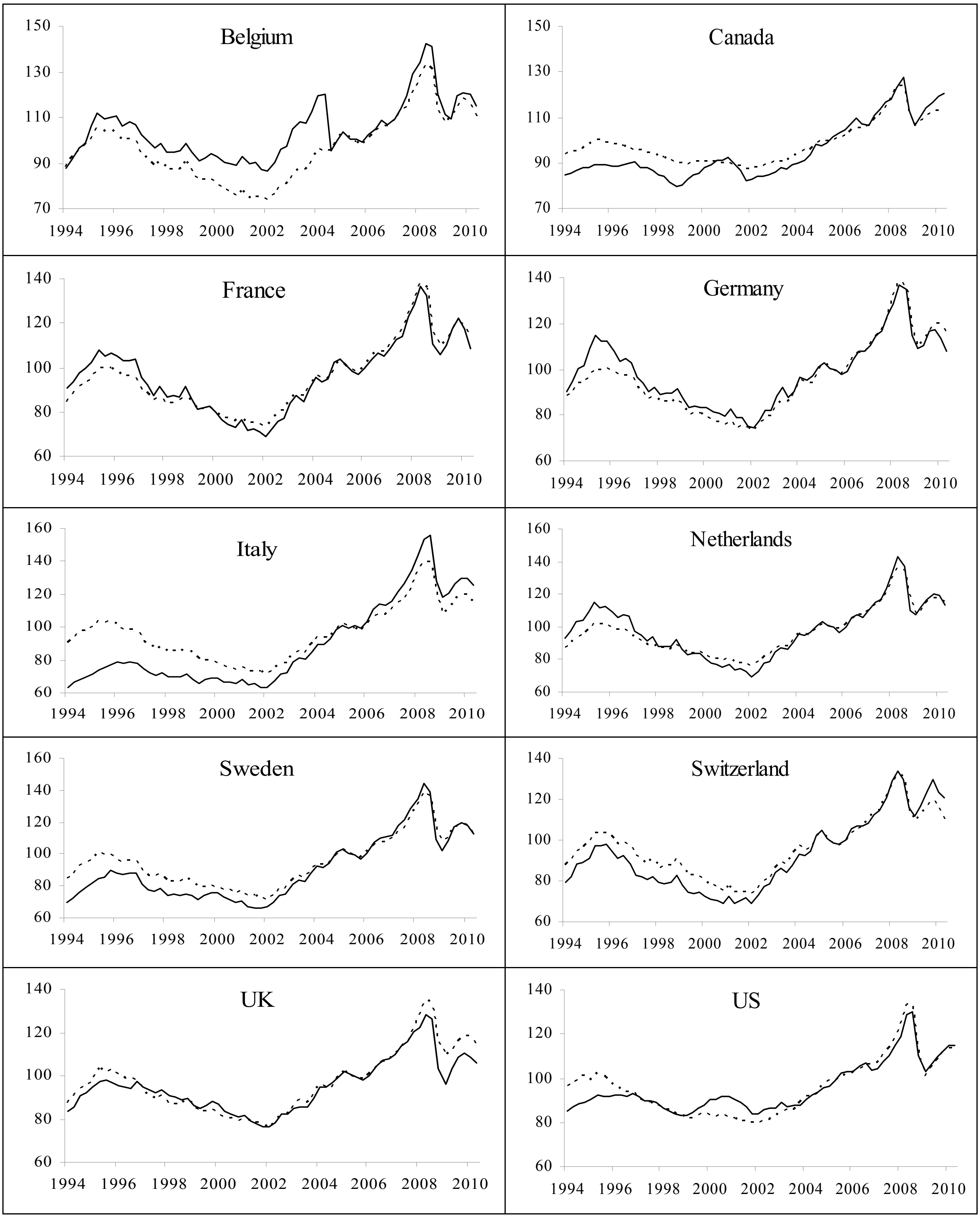


Figure 3. PPP based import price calculated for developed countries, Π_{Dt} (solid line) and emerging market economies, Π_{Et} (dotted line)

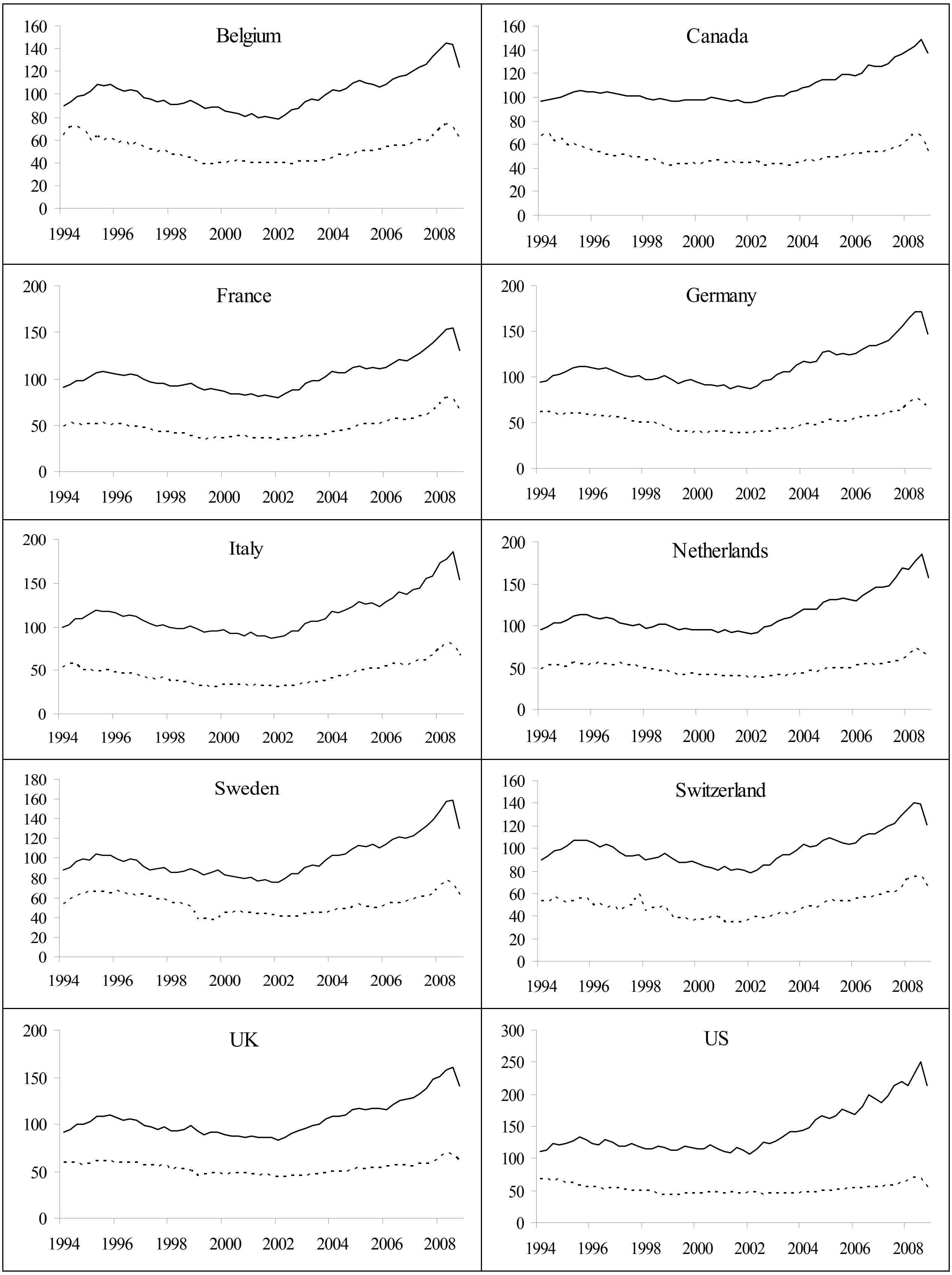
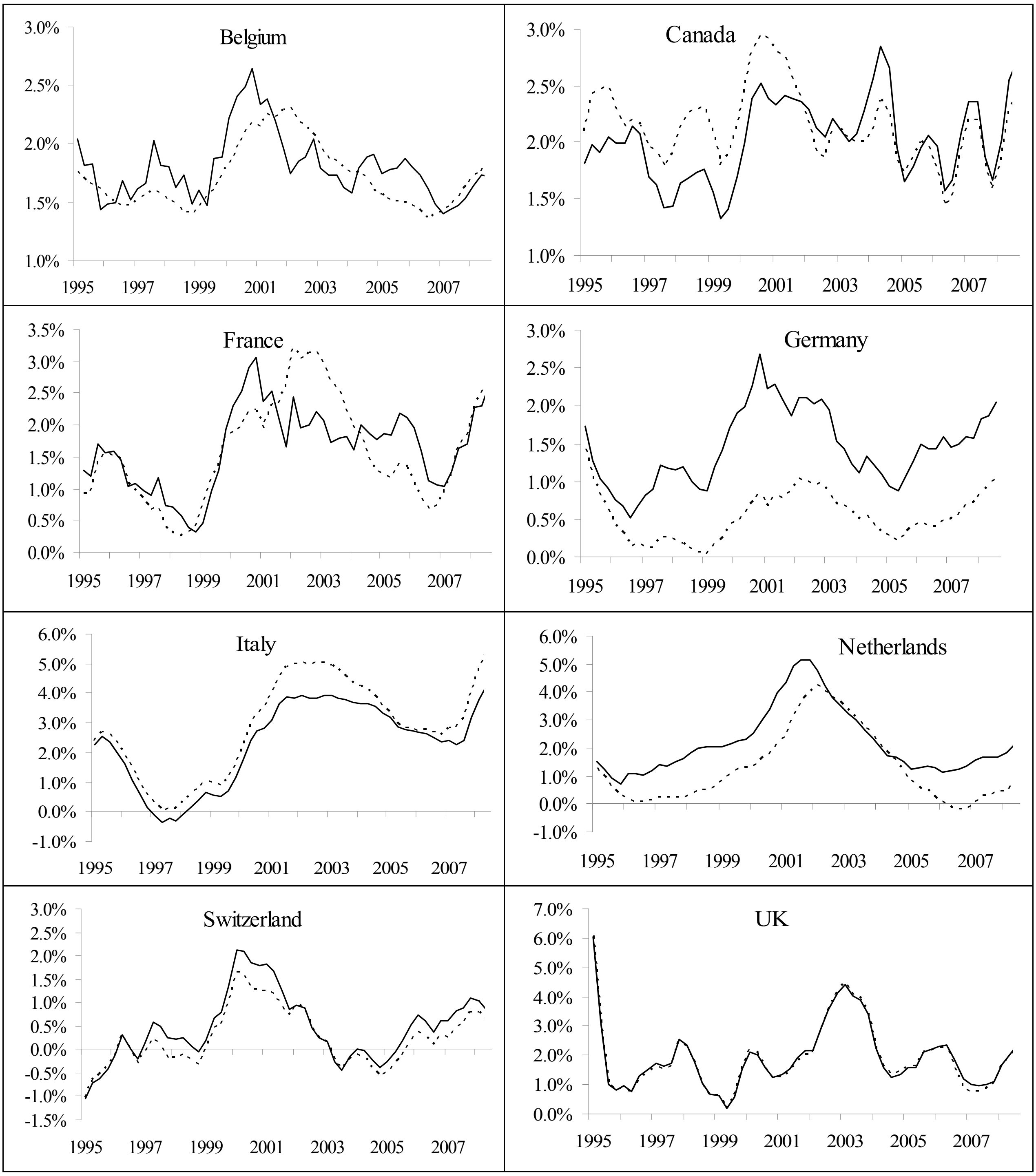


Figure 4. Simulated impact of the openness indices (solid line: baseline inflation; dotted line: simulated inflation with r_{it}^{O} fixed at the 1994Q1 value)



Note: No effect for Sweden and the US as the selected model version is without the indices; the UK result is based on the model version with the index.

Figure 5. Simulated impact of the shares of imports from the developed countries versus the emerging market economies (solid line: baseline inflation; dotted line: simulated inflation with W_{Et} fixed to its 1994Q1 value)

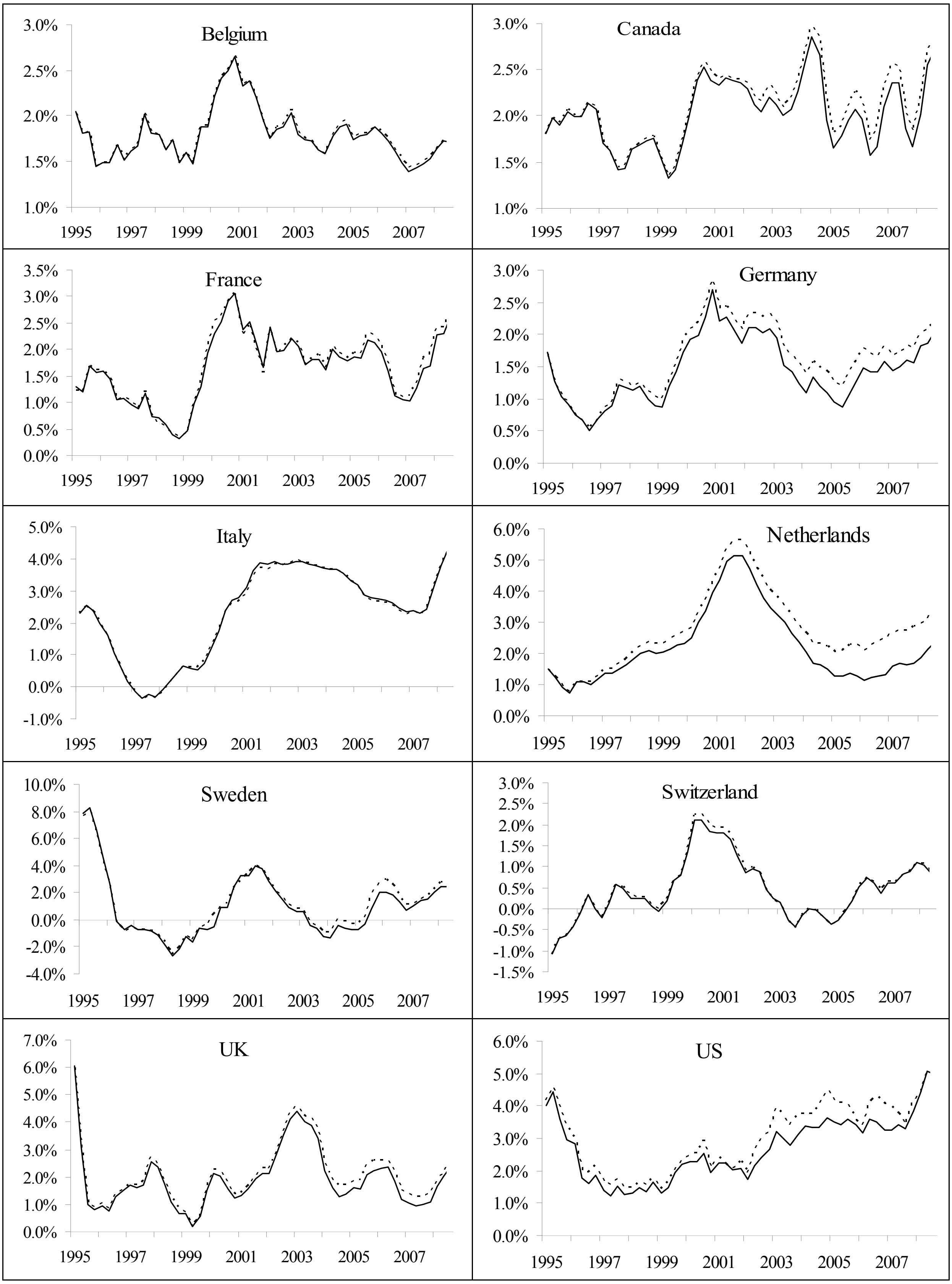


Figure 6. Simulated impact of the import prices from the emerging market economies (solid line: baseline inflation; dotted line: simulated inflation with $\Pi_{Et} = \Pi_{Dt}$)

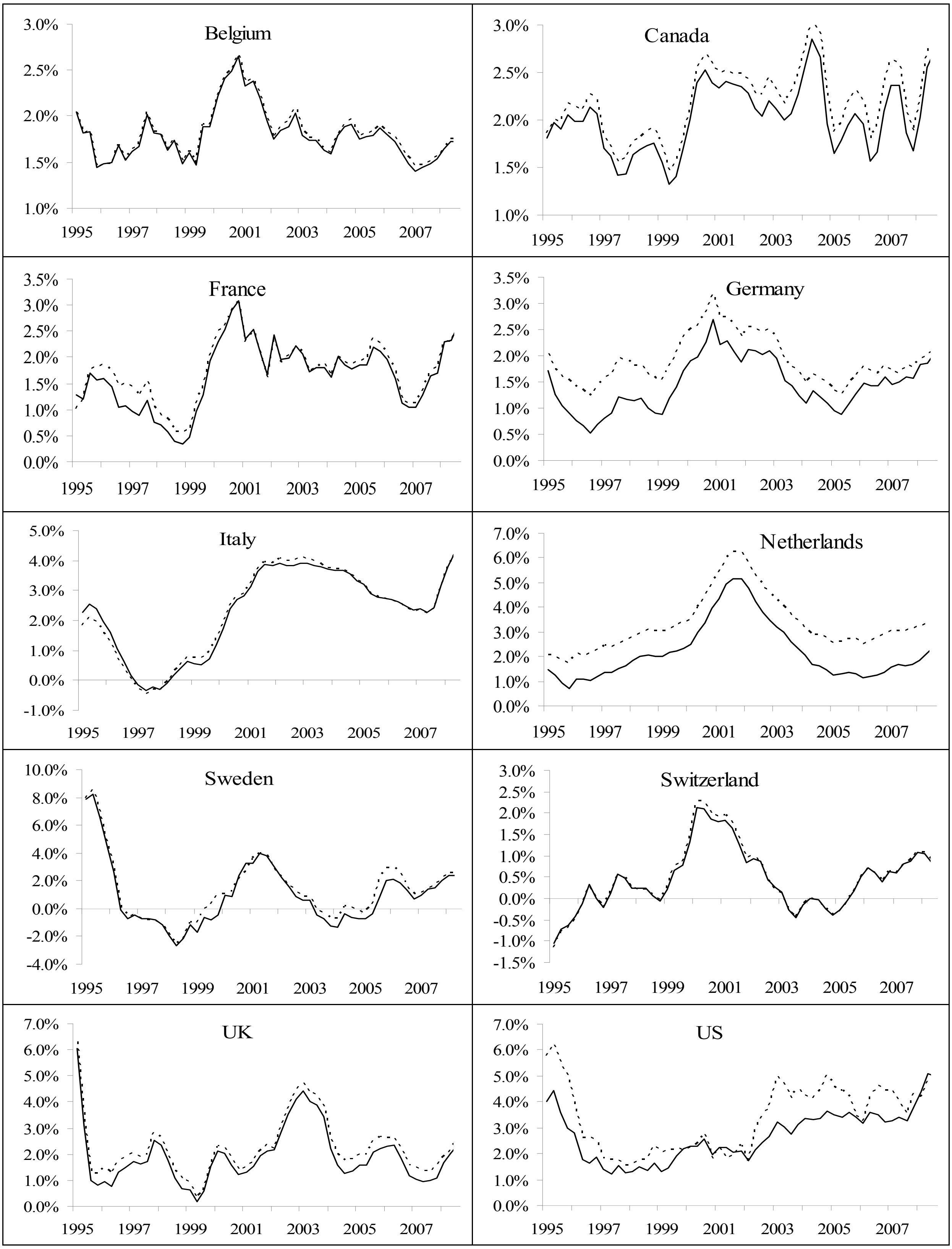


Table 1. Correlation coefficients of CPI inflation

Upper triangle: 1998Q1 – 2010Q3; lower triangle: **1992Q1 – 2010Q3**

	BEL	CAN	CHE	DEU	FRA	UK	ITA	NLD	SWE	US
BEL	1	0.37	**0.65**	**0.62**	0.64	**0.50**	0.41	**0.42**	0.48	0.70
CAN	0.41	1	**0.61**	**0.08**	**0.77**	**0.68**	**0.67**	-0.20	**0.78**	**0.69**
CHE	0.60	0.32	1	0.72	**0.71**	**0.65**	**0.75**	0.29	**0.82**	**0.72**
DEU	0.57	0.06	0.85	1	0.40	**0.28**	0.42	**0.60**	0.41	0.44
FRA	0.79	0.50	0.67	0.62	1	**0.71**	**0.81**	-0.09	**0.78**	**0.78**
UK	0.43	0.32	0.31	0.27	0.47	1	**0.63**	-0.11	**0.75**	**0.75**
ITA	0.42	0.12	0.74	0.69	0.62	0.22	1	-0.02	**0.82**	**0.63**
NLD	0.40	0.20	0.37	0.47	0.32	-0.09	0.44	1	0.05	0.05
SWE	0.57	0.31	0.66	0.69	0.64	0.19	0.62	0.50	1	**0.67**
US	0.73	0.60	0.61	0.48	0.71	0.55	0.46	0.20	0.42	1

Note: The coefficients in bold in the upper triangle indicate those which are larger than their corresponding coefficients in the lower triangle.

Table 2. Correlation coefficients of wage rates

Upper triangle: **1998Q1 – 2009Q4**; lower triangle: 1992Q1 – 2009Q4

	BEL	CAN	CHE	DEU	FRA	UK	ITA	NLD	SWE	US
BEL	1	-0.44	**0.33**	0.26	-0.01	0.03	0.02	0.36	0.39	-0.04
CAN	-0.20	1	-0.37	-0.27	0.22	**0.33**	**0.52**	-0.05	-0.08	**0.53**
CHE	-0.04	-0.33	1	**0.39**	**0.25**	**-0.06**	**-0.04**	**0.27**	**0.51**	**0.15**
DEU	0.47	0.07	-0.11	1	0.14	**0.06**	0.02	0.18	**0.57**	0.04
FRA	0.19	0.28	0.03	0.42	1	**0.02**	**0.47**	0.50	0.30	**0.61**
UK	0.23	0.25	-0.18	0.01	-0.01	1	0.19	-0.08	0.46	**0.25**
ITA	0.21	0.49	-0.23	0.16	0.45	0.26	1	0.44	0.29	**0.55**
NLD	0.46	0.07	-0.14	0.47	0.54	-0.04	0.48	1	0.21	**0.37**
SWE	0.50	-0.01	-0.03	0.42	0.32	0.56	0.38	0.27	1	**0.35**
US	-0.07	0.40	-0.01	0.33	0.49	-0.18	0.29	0.34	0.01	1

Note: The coefficients in bold in the upper triangle indicate those which are larger than their corresponding coefficients in the lower triangle.

Table 3. Correlation coefficients of import prices

Upper triangle: **1998Q1 – 2010Q3**; lower triangle: **1992Q1 – 2010Q3**

	Energy	Brent	Food	BEL	CAN	CHE	DEU	FRA	UK	ITA	NLD	SWE	US
Energy	1	0.89	0.45	**0.19**	**-0.17**	0.45	**0.37**	**0.53**	0.58	**0.24**	**0.54**	0.60	**0.36**
Brent	0.90	1	0.46	**0.30**	**-0.01**	0.51	**0.50**	0.58	0.69	**0.30**	**0.68**	0.69	**0.47**
Food	0.56	0.54	1	0.19	**-0.17**	0.12	0.13	0.19	0.28	0.25	0.30	0.30	**0.12**
BEL	0.08	0.23	0.26	1	0.28	**0.38**	**0.66**	**0.51**	**0.57**	**0.36**	**0.58**	**0.63**	**0.48**
CAN	-0.27	-0.10	-0.20	0.28	1	**-0.01**	0.47	0.14	0.21	0.38	**0.19**	0.21	0.41
CHE	0.50	0.56	0.28	0.14	-0.08	1	**0.67**	**0.71**	**0.78**	**0.12**	**0.76**	**0.76**	**0.47**
DEU	0.28	0.44	0.23	0.57	0.57	0.45	1	0.76	**0.84**	**0.48**	**0.80**	**0.89**	**0.72**
FRA	0.50	0.65	0.35	0.43	0.24	0.61	0.79	1	**0.83**	**0.31**	0.84	**0.79**	**0.63**
UK	0.60	0.73	0.53	0.45	0.25	0.58	0.76	0.77	1	0.50	**0.89**	**0.96**	**0.70**
ITA	0.12	0.24	0.34	0.31	0.42	-0.02	0.46	0.22	0.56	1	**0.34**	0.54	0.54
NLD	0.49	0.66	0.44	0.46	0.17	0.62	0.70	0.90	0.81	0.27	1	**0.86**	**0.59**
SWE	0.60	0.72	0.55	0.54	0.25	0.57	0.83	0.77	0.93	0.56	0.77	1	**0.71**
US	0.16	0.26	0.10	0.37	0.45	0.21	0.63	0.36	0.53	0.58	0.33	0.58	1

Note: Reuters CRB energy price index; Brent crude from IMF. The coefficients in bold in the upper triangle indicate those which are larger than their corresponding coefficients in the lower triangle.

Table 4. Key estimates and test statistics from model reduction of the inflation models (1), (2) and (2a):

	Δp_{t-j}		ec_{it-1}			Δw_{t-j}			$\Delta p^{M}{}_{t-j}$			u_{t-j}				y^{G}_{t-j}					Residual tests	
	α_1	α_2	γ	κ_1	κ_2	λ_0	λ_1	λ_2	β_0	β_1	β_2	δ_1	δ_2	δ_3	δ_4	φ_1	φ_2	φ_3	φ_4	R^2	Normality [p value]	Homogeneity [p value]
BEL	0.726		**-0.017**	**0.4**	**0.1**				**0.017**	**-0.017**		**-0.003**								0.634	3.108	0.248
	[.086]		**[.008]**						**[.007]**			**[.001]**									[.211]	[.979]
	[.096]		**[.081]**						**[.056]**			**[.109]**										
CAN	0.677	-0.329	**-0.072**	**0.75**	**0.25**	**0.072**			**0.033**		**-0.02**							0.001		0.648	0.039	1.89
	[.117]	[.118]	**[.043]**			**[.012]**			**[.011]**		**[.008]**							[.0004]			[.981]	[.052]
	[.081]	[.035]	**[.048]**			**[.036]**			**[.093]**		**[.126]**							[.262]				
FRA	0.73		**-0.171**	**0.45**	**0.15**			**-0.089**	**0.069**	**-0.071**		-0.002								0.888	1.927	0.886
	[.06]		**[.029]**					**[.027]**	**[.007]**	**[.011]**		[.0003]									[.382]	[.624]
	[.061]		**[.049]**					**[.041]**	**[.614]***	**[.171]**		[.046]										
DEU	0.788		**-0.077**	**0.2**	**0.3**				**0.04**	**-0.027**										0.865	2.399	0.792
	[.047]		**[.022]**						**[.007]**	**[.006]**											[.301]	[.612]
	[.097]		**[.227]**						**[.115]**	**[.04]**												
ITA	0.889		**-0.053**	**1**	**0**		-0.15	-0.177		-0.013		**0.006**		**-0.006**		**0.004**		**-0.003**		0.973	5.694	0.527
	[.032]		**[.012]**				[.043]	[.041]		[.005]		**[.001]**		**[.001]**		**[.0005]**		**[.0004]**			[.058]	[.929]
	[.038]		**[.037]**				[.052]	[.035]		[.081]		**[.032]**		**[.031]**		**[.074]**		**[.08]**				
NLD	0.658		**-0.057**	**0.25**	**0.75**		**-0.017**		**0.015**			**0.007**			**-0.009**					0.865	4.723	2.009
	[.074]		**[.011]**				**[.005]**		**[.007]**			**[.002]**			**[.002]**						[.094]	[.04]
	[.105]		**[.099]**				**[.024]**		**[.082]**			**[.066]**			**[.053]**							
SWE	0.764		-0.231	0.1	0.4				0.218	-0.142									-0.001	0.864	0.645	0.609
	[.058]		[.048]						[.025]	[.026]									[.0002]		[.724]	[.799]
	[.081]		[.27]						[.076]	[.05]									[.113]			
CHE	0.768	-0.339	**-0.2**	**0.1**	**0.15**	**0.016**			**0.027**					-0.003		0.002	-0.003			0.88	0.619	0.838
	[.104]	[.094]	**[.03]**			**[.007]**			**[.005]**					[.0006]		[.0009]	[.0006]				[.734]	[.638]
	[.137]	[.249]	**[.187]**			**[.172]**			**[.223]**					[.16]		[.035]	[.06]					
UK	0.919	-0.379	-0.219	0.7	0.3	0.421			0.098	-0.062							0.004	-0.005		0.919	0.904	1.473
	[.085]	[.087]	[.034]			[.079]			[.02]	[.02]							[.001]	[.001]			[.636]	[.194]
	[.072]	[.081]	[.125]			[.123]			[.035]	[.149]							[.088]	[.071]				
	0.919	-0.378	**-0.206**	**0.7**	**0.3**	0.421			0.101	-0.063							**0.006**	**-0.007**		0.919	0.833	1.315
	[.085]	[.088]	**[.032]**			[.079]			[.02]	[.019]							**[.002]**	**[.002]**			[.659]	[.275]
	[.073]	[.081]	**[.121]**			[.127]			[.042]	[.168]							**[.112]**	**[.09]**				
US	0.6		-0.236	0.75	0.2				0.155	-0.08		-0.004		0.01	-0.008		-0.002	0.002		0.954	5.207	1.196
	[.088]		[.051]						[.009]	[.017]		[.001]		[.003]	[.002]		[.0009]	[.0008]			[.074]	[.307]
	[.06]		[.04]						[.107]	[.035]		[.03]		[.032]	[.035]		[.046]	[.05]				

Note: Statistics in brackets below the parameter estimates are standard errors; the bracketed statistics below the standard errors are Hansen parameter constancy tests(the 5% critical value being 0.47); parameter estimates in bold are weighted variables. Sample 1992Q1-2010Q3; exception: Belgium up to 2007Q4; Only versions reported are those which pass the encompassing tests, with UK having two versions. The short-run coefficient estimates for the import price variable in the Belgium case is actually the result of model reduction on an acceleration variable, ie $\Delta\Delta p^{M}{}_{t}$.

Table 5. Summary impact on inflation from model simulations

	Average inflation (sample mean in %)		Inflation variability (standard deviation)		Inflation persistence (Marques's *r*)	
	1995-2008	2000-2008	1995-2008	2000-2008	1995-2008	2000-2008
Belgium	1.79	1.85	0.28	0.31	0.56	0.60
Scenario 1	-4.2%	-2.1%	-4.2%	-6.3%	0.56	0.54
Scenario 2	+0.7%	+0.9%	-0.1%	-1.0%	0.56	0.60
Scenario 3	+1.5%	+1.8%	+0.1%	-1.0%	0.55	0.60
Canada	2.03	2.19	0.36	0.32	0.51	0.49
Scenario 1	+5.5%	-1.9%	-7.7%	+22.0%	0.53	0.54
Scenario 2	+4.5%	+6.0%	+8.2%	-2.6%	0.49	0.49
Scenario 3	+8.6%	+9.3%	+5.4%	-2.0%	0.49	0.49
France	1.65	1.98	0.63	0.47	0.44	0.51
Scenario 1	-2.4%	+0.3%	+29.7%	+57.8%	0.55	0.51
Scenario 2	+2.5%	+2.9%	+3.0%	-1.3%	0.42	0.54
Scenario 3	+6.2%	+2.0%	-10.0%	-2.9%	0.42	0.51
Germany	1.45	1.67	0.49	0.43	0.55	0.51
Scenario 1	-62.2%	-60.9%	-34.9%	-44.1%	0.51	0.46
Scenario 2	+12.2%	+14.4%	+8.2%	-9.9%	0.47	0.54
Scenario 3	+31.6%	+21.3%	-8.6%	+12.8%	0.60	0.60
Italy	2.37	3.24	1.41	0.66	0.36**	0.46
Scenario 1	+23.7%	+20.7%	+15.7%	+48.3%	0.53	0.46
Scenario 2	-1.3%	-1.5%	-1.0%	+2.1%	0.38*	0.46
Scenario 3	-0.1%	+1.5%	+2.9%	+4.1%	0.42	0.46
Netherlands	2.21	2.56	1.16	1.27	0.64**	0.60
Scenario 1	-42.7%	-34.9%	+10.0%	+11.0%	0.62*	0.54
Scenario 2	+24.1%	+28.7%	+3.7%	-15.3%	0.60	0.57
Scenario 3	+51.3%	+47.5%	-2.4%	-10.0%	0.64**	0.60
Sweden	1.09	1.31	2.35	1.52	0.56	0.49
Scenario 2	+17.5%	+21.7%	-3.1%	-4.9%	0.55	0.46
Scenario 3	+27.8%	+23.9%	-2.1%	-8.9%	0.55	0.49
Switzerland	0.47	0.67	0.71	0.72	0.51	0.51
Scenario 1	-46.3%	-35.7%	-16.3%	-16.4%	0.49	0.51
Scenario 2	+5.7%	+4.5%	+5.0%	+6.6%	0.51	0.51
Scenario 3	+3.1%	+3.6%	+7.1%	+7.6%	0.53	0.51
UK	1.94	2.14	1.10	0.95	0.58	0.60
Scenario 1	-2.3%	-2.2%	+2.5%	+5.2%	0.58	0.57
Scenario 2	+9.2%	+11.1%	+0.7%	-1.4%	0.56	0.60
Scenario 3	+15.8%	+14.6%	-0.7%	-0.3%	0.64**	0.60
US	2.68	3.03	1.01	0.86	0.49	0.40
Scenario 2	+12.7%	+13.5%	+7.4%	+5.6%	0.49	0.34*
Scenario 3	+25.0%	+19.8%	+29.2%	+26.0%	0.47	0.40

Note: Marques's (2004) measure of inflation persistence, *r*, is defined as $r = 1 - n/T$, where *n* stands for the number of times the series crosses the mean during a time interval with *T*+1 observations. *r* is normally distributed with mean 0.5 and variance of $0.5/\sqrt{T}$. The superscripts ** and * in the last two columns indicate the corresponding *r* exceeding the significance levels of 95% and 90% respectively.

Of the first four columns, The summary statistics in the first rows of each country are calculated from the baseline simulation. The statistics in the rows of three scenarios are calculated as percentage differences of the scenarios against the baseline.