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Abstract

Despite its strong theoretical position when it comes to explaining inflation in transition economies, the empirical merits of the Balassa-Samuelson (B-S) effect are weak. This paper points to three theory-based contributing factors to these weak findings and offers an alternative approach. First, the short-term focus makes B-S prone to underestimating the magnitude of the productivity growth differential. Second, the conventional demand side CPI based sectoral composition reduces the extent to which the productivity growth differential is passed through to inflation. Third, by ignoring the dependence between the two main B-S components, a second downward bias to the productivity growth pass through comes about. The key to our proposed alternative centres around an endogenous relation between the productivity growth differential and sector sizes. The long-run supply-side approach allows us to capture inflation drivers that conventional B-S fails to incorporate. The paper provides a blueprint for future empirical analysis.

JEL classifications: P2, O14

Keywords: Balassa-Samuelson, structural inflation, Scandinavian Model of Inflation, reallocation, restructuring.

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1. Introduction

Despite its strong theoretical position when it comes to explaining inflation and real exchange rate developments in transition economies, the empirical merits of the Balassa-Samuelson (B-S) effect are weak.¹ In fact, over the last years several papers have claimed the B-S effect irrelevant for the difficulties transition economies in eastern-Europe have encountered in complying with the Maastricht inflation criterion.²

Irrespective of weak empirical estimates, the role of structural inflation should not be taken lightly. Countries transitioning from centrally planned economies to market economies experience large structural changes in compressed time. Common sense suggests that structural shifts of such magnitude will be accompanied by inflation originating in structural causes. If there is anywhere a showcase for structural inflation it should be found in this type of economy. For decades economists have been attracted by these features, trying to highlight causal relations between the epochal structural shifts and inflation – in particular along the lines of B-S.³

However, questions regarding how the B-S effect typically is analyzed seem to remain. The purpose of this paper is first of all to identify some of the theory-based reasons for why the empirical support for structural inflation, as manifested by the B-S effect, has been so disappointing. Second, the paper proposes an alternative conceptual approach. The paper essentially argues that the reason why we still have not found what we are looking for is that we have been looking in the wrong places.

The literature on the B-S effect, as described by for example Égert (2002a), concern itself with how productivity growth in the tradable sector outpaces that of the non-tradable sector. Under the assumption that wage growth is roughly equal between sectors, wages increase in both sectors. As a consequence the relative price of non-tradable goods rises, and inflation picks up. This way the theory establishes a causal relation between sectoral productivity growth and structural inflation.

The B-S analysis has gone through a number of variations and extensions. The original supply side orientation by Balassa and Samuelson⁴ has been extended to include demand side variables, such as per capita income and government expenditures.⁵ Recent applications also distinguish between a so-called internal (or domestic) B-S effect and an external (or international) one. Both versions of the B-S effect are

¹ For example, for a selection of East European economies Mihaljek and Klau (2008) show, on average, the short run ‘domestic B-S effect’ to be 0.13%, the long run ‘domestic B-S effect’ 1.1%, the short run ‘international B-S effect’ 0.1%, and the long run ‘international B-S effect’ 1.2%. Mihaljek and Klau (2004) report that the B-S effect, in countries of Central and Eastern Europe, on average only explains between 0.2 % and 2 % of the annual inflation differentials relative to the euro area. Small effects are also reported, for example, Cipriani (2000), Coricelli & Jazbec (2001), Égert (2002a), Égert (2002b), Égert et al (2003), Flek et al (2003), and Kovács (2002).

² For example, Égert (2005) concludes that the B-S effect plays only a very limited role in the determination of inflation and real exchange rate movements. Breuss (2003) concludes that the B-S effect is no obstacle for the east European euro area aspirants. Furthermore, the hypothesis that structural factors related to changes in productivity are NOT significant inflation drivers in transition economies has prompted a search for other causal relations germane to the transition experience. For example Égert and Podpiera (2008) advance an alternative explanation in their ‘quality bias hypothesis’.

³ For a review of the literature on the B-S effect, see for example, Égert (2003) or Égert et al (2006).

⁴ See Balassa (1964) and Samuelson (1964). See also Rogoff (1996) or Obstfeld & Rogoff (1996) for a description of the ‘original’ supply side perspective of B-S analysis.

⁵ For B-S analysis extended to include the demand side, see Bergstrand (1991) or De Gregorio et al. (1994)

hypotheses about structural causes of inflation. The international version focuses on the tendency for inflation in catching-up economies to exceed that of the economies they are converging to. In the domestic version The B-S effect represents the tendency for the domestic prices of non-tradable goods to rise faster than the prices of tradables (Mihaljek and Klau, 2008).

In this paper we argue that B-S analysis is beset by three unfortunate features that prevent it from capturing that which it is seeking. These features reside on the theoretical side. First, although usually thought of as a supply side model, closer examination of its typical formulation reveals a clear demand side channel. Second, and more importantly, structural changes evolve over the longer term. However, by construction, B-S has a short-term orientation. Third, the B-S effect treats as independent what in reality are strongly related elements: the productivity growth differential between sectors and the sectors relative magnitude.

Taking these shortcomings into account suggests a blueprint for an alternative approach when estimating structural inflation and the B-S effect. This entails a re-focusing on the supply side, the longer term and on the interdependence between the two main factors determining how structural shifts impact on inflation. This interdependence allows contemporaneous-, as well as leading- and lagging values of the productivity growth differential to impact on sector sizes, and, eventually structural inflation. In the absence of leading- or lagging relations between the productivity growth differential and sector sizes, our approach reduces to the conventional B-S approach.

The long-run perspective implies that we abstract from (often erratic) year-on-year changes of structural inflation drivers, in favor of cumulative changes and their annual averages, in line with the long-term processes underlying transition. Structural inflation can now vary both over time and between countries at different stages of transition for two reasons: changes in the productivity growth differential, and changes in how the differential is passed through to inflation. In particular, by endogenising relative sector sizes, we can assess how the impact of the productivity growth pass-through on structural inflation changes over time.

In this context it is useful to regard the B-S effect as a component of a more general variant of the structural inflation hypothesis - decidedly anchored in the supply side and decidedly long-term - that has become known as the Scandinavian Model of Inflation.⁶

Structural inflation is the contribution to inflation from the real side of the economy. As the real factors are related to the structural shifts at the heart of the transition process they hold a promise of future growth and higher standard of living. Structural inflation should thus be less worrisome to policy makers than the nominal (monetary) contribution to inflation. Yet, the Maastricht Convergence Criterion on inflation, which has been a barrier to euro zone entry for a number of East European EU member states, does not distinguish between real and nominal contributions to inflation. Considering that the East European new EU member states still have a long way to go to be at par with the standard of living of West European economies and their economic structures, it is to be expected that structural inflation will persist into the foreseeable future.

If structural inflation accounts for a significant portion of overall inflation, and is expected to persist, it puts a question mark over the appropriateness of the Maastricht convergence criteria for transition economies aspiring to join the euro area. In this context the magnitude of the structural component to overall inflation is significant for policymakers. So far, traditional B-S analysis with its weak empirical support has backed up West European policy-makers' opinions that special considerations for transition economies are not warranted.⁷ In this paper we present analytical foundations for a potential reconsideration of this opinion.

⁶ See Lindbeck (1979) for an exposition of the Scandinavian Model of Inflation.

⁷ The official stance of the European Commission and the European Central bank, expressed in 2001 as follows, has essentially not changed: "...notwithstanding its importance, the Balassa-Samuelson effect should not be overstated when explaining current inflation rates in the accession countries.... The Maastricht inflation criterion, which will not be revised to take into account any possible Balassa-Samuelson effect, should not be seen as an immediate requirement for these countries, but rather as a medium-term objective for central banks." (Christian Noyer, 2001)

The paper is structured as follows: In Section 2 we document the distinction between short- and long-term measures of B-S and structural inflation, and pinpoint the shortcomings of the former. A long-term supply side focused approach for structural inflation based on the Scandinavian Model of Inflation is derived in Section 3. The model endogenises the relationship between sector sizes and the productivity growth differential, the two main components of the B-S effect, and highlights the distinction between short- and long-run measures. The implications for transition are developed in Section 4. The relationship between the productivity growth pass-through and its underlying causes is discussed in Section 5. The last part concludes.

2. Conceptual considerations: Structural inflation and Balassa-Samuelson

When the empirical findings of the B-S effect are declared to be weak two types of attitudes may be conveyed. One perspective is that the B-S effect is weak because structural inflation drivers are weak, and that - like it or not - this is simply what the data tells us (Égert and Podpiera, 2008). The other perspective is that the data harbors strong evidence of structural inflation drivers, but the conventional B-S methodology fails to capture it. It is this latter perspective that we pursue in this section. The core of our argument is that long-run supply side transition dynamics come in two layers, which in the following is referred to as *reallocation* and *restructuring*, terms which are to be defined later. The paper argues that the conventional B-S effect captures the former, but not the latter.

In the short-term the relative sizes of the tradable and the non-tradable sector (key elements in B-S analysis) are fixed. Profit-seeking behavior is confined to finding improvements in factor proportions, to increase productivity, product quality, improve work organization and managerial practices, and other activities compatible with fixed relative sector sizes. Economic expansion or decline would affect all sectors simultaneously. The economy may grow or shrink, but relative sector shares remain unchanged. Blanchard (1997), for example, points out that the stark shrinkage of output in the very beginning of transition was distributed evenly across all sectors. This would fit within our frame of reference of fixed relative sector shares. The accompanying impact on inflation is a *short-term effect*.

However, Blanchard (1997) continues with “...over time, there has been increasing differentiation across sectors, and there now appears to be slow convergence of sectoral composition to that observed in OECD countries”.⁸ This describes what is meant by long-term or large scale dynamics: Changes in relative sector sizes through reallocation or restructuring processes. We will refer to the effects of changing relative sector sizes on inflation as *long-term effects*.

In this frame of reference we define transition as a shift toward a larger share of the non-tradable sector - essentially in agreement with Blanchard (1997). Viewed from this perspective the structural shifts at the very heart of transition essentially remain outside the conventional B-S analysis. This may be an obvious reason for its weak empirical results. Another potential cause is that relative sector sizes are typically defined as shares in the CPI rather than in GDP.

We will address these potential reasons for the weak B-S effect one by one, and in more detail below. Let us take as a point of departure the definition of structural inflation (\dot{P}_{STR}) as suggested by the Scandinavian Model of Inflation, which is in congruence with B-S methodology⁹

$$1) \quad \dot{P}_{STR} = ((1 - \alpha)[\dot{q}_T - \dot{q}_{NT}])$$

where $(1-\alpha)$ denotes the relative size of the non-tradable sector and $[\dot{q}_T - \dot{q}_{NT}]$ the productivity growth differential between the tradable and non-tradable sector. The original structural inflation hypothesis does

⁸ Blanchard (1997), pp. 5.

⁹ See again Lindbeck (1979) for the Scandinavian Model of Inflation, and Mihaljek and Klau (2008) for the conventional B-S framework.

not concern itself with inter-temporal considerations, and is thus, in principle, subject to a variety of extensions and interpretations. The two dominant variants are:

- (i) Fixed relative size of the non-tradable sector pre-multiplying a sum of time-indexed productivity growth differentials¹⁰

$$2a) \quad (1-\alpha) \sum_{j=t}^T (\dot{q}_T - \dot{q}_{NT})_j$$

- (ii) Alternatively, the products of time-indexed productivity growth differentials and time-indexed relative size of the non-tradable sector summed over the relevant time horizon. Note that here *contemporaneous* non-tradable sector size and *contemporaneous* productivity growth differentials are the factors of the products, i.e. $(1-\alpha)$ and $(\dot{q}_T - \dot{q}_{NT})$ have always the same time index.¹¹

$$2b) \quad \sum_{j=t}^T (1-\alpha)_j (\dot{q}_T - \dot{q}_{NT})_j$$

Expressions (2a) and (2b) are interpreted as *structural inflation over a period of time*, i.e. the part of inflation that has its origin in the real side of the economy, as opposed to the monetary side. To obtain average annual values of structural inflation expression (2a) and/or (2b) are divided by the number of years under observation.

Three comments are in order: (i) As mentioned above, analysis of the B-S effect typically computes the relative size of the non-tradable sector, $(1-\alpha)$, by taking the sector's share in the CPI rather than its share in GDP. This, while analytically not incorrect, has been shown to underestimate the sector's size, and, by implication, underestimate the B-S effect. This is particularly so for the transition economies of Eastern Europe. For example, as Mihaljek and Klau (2008) point out, market-based non-tradables are responsible for only around 20%-30% of the Baltic States' CPI basket, while typically contributing more than 60% to valued added. This implies that switching from CPI to GDP when calculating the size of the non-tradable sector will augment the B-S effect. Even so, CPI-based (i.e. demand side) sectoral share computations are doubtful when explaining structural inflation.

(ii) Standard B-S analysis takes the size of the non-tradable sector $(1-\alpha)$ and the productivity growth differences between tradable and non-tradable sectors $(\dot{q}_T - \dot{q}_{NT})$ as independent of each other. A dependency relation is however argued by Borgersen and King (2009). In particular, relative sector sizes are argued to depend on the productivity growth differential between sectors. So, if for example productivity growth in the tradable sector is stronger than in the non-tradable sector the tradable sector will expand relative to the non-tradable sector.

(iii) Accepting a dependence relation, as described in (ii), and defining relative sector size as a function of productivity growth differences, de facto rules out expression (2a) since here the sector size $(1-\alpha)$ is constant, as indicated by the absence of a time index.

In contrast to (2a), expression (2b) accommodates a dependence of the relative sector size $(1-\alpha)$ on the productivity growth difference $(\dot{q}_T - \dot{q}_{NT})$. However, a new question arises: Why should sector size at time t depend only on productivity growth differential at time t ? Would it not be more plausible that sector size at time t also depends on productivity growth in earlier years? After all, it will take time to change sector sizes in response to productivity growth signals. And further, is not plausible that sector sizes depend

¹⁰ The majority of papers dealing with the B-S effect are of this kind, as a review of the survey papers Égert, Balázs (2003), and/or Égert et al. (2006) reveals.

¹¹ For example Mihaljek and Klau (2008) take this approach.

on expectations about future productivity growth? Such expectations could, for example be raised by announcements of economic policy that favors a particular sector. This would attract entrepreneurial activity and investment into this sector even before such policy is enacted, in order to secure a ‘first move advantage’. In other words, should we not consider both *leads* and *lags* in the relationship between the productivity growth differential and sector sizes? This also fits nicely with the long-term orientation of the Scandinavian Model of Inflation and its strong anchoring in the supply side.

The mathematical expression analogous to (2b), but in contrast to (2b), capturing leads and lags in the above sense is given by¹²

$$3) \quad \sum_{j=t}^T (1 - \alpha)_j \sum_{i=t}^T (\dot{q}_T - \dot{q}_{NT})_i$$

We present expression (3) as an alternative formulation of *structural inflation*, and refer to it as *cumulative structural inflation*. As before, average annual values of cumulative structural inflation are obtained by dividing the expression by the number of years under observation. In the following we refer to expression 3) as the long-run B-S effect.

As shown in Borgersen and King (2009) for the case of Latvia, in a simple accounting framework, an analysis along the lines of cumulative structural inflation assigns a strong role to structural factors impacting on inflation. In standard B-S analysis erratic year-on-year jumps between advances in productivity of the tradable sector alternating with advances in productivity in the non-tradable sector make these manifestations of short- term supply side factors effectively cancelling each other out, – giving the misleading impression that structural factors exert only a weak influence on inflation. Defining structural inflation according to equation (3) mitigates these mutually cancelling effects, and contributes to a stronger impact of structural inflation drivers.

Furthermore, expression (3) incorporates leads and lags in the relation between the relative size of the sectors and the productivity growth differential $(\dot{q}_T - \dot{q}_{NT})$. Structural shifts depend on an array of past, current and expected future productivity growth differentials, acting as signals for profit seeking investors. In addition to the current productivity growth differential, investments are motivated by expectations of upcoming productivity growth in a sector (leads), and past productivity growth differentials which might have lagging effects on investments and sector sizes.

So, using expression (3) serves a dual purpose: First, it mitigates the ‘cancelling out effect’ of year-on-year reversals in productivity growth differentials between tradable and non-tradable sector. Second, and more significantly, equation (3) captures something that is missed by standard B-S analysis: The longer term structural shifts at the heart of transition that bring about changes in sectoral composition. For illustrative purposes we expand expression (3), and arrange its terms in matrix form.

¹² Note that while expression (2b) is a sum of products, expression (3) is a product of sums.

Table 1: Productivity growth differentials and sector size

$(1-\alpha)_t(\dot{q}_T - \dot{q}_{NT})_t$	$(1-\alpha)_t(\dot{q}_T - \dot{q}_{NT})_{t+1}$	$(1-\alpha)_t(\dot{q}_T - \dot{q}_{NT})_{t+2}$	•	•	$(1-\alpha)_t(\dot{q}_T - \dot{q}_{NT})_{T-1}$	$(1-\alpha)_t(\dot{q}_T - \dot{q}_{NT})_T$
$(1-\alpha)_{t+1}(\dot{q}_T - \dot{q}_{NT})_t$	$(1-\alpha)_{t+1}(\dot{q}_T - \dot{q}_{NT})_{t+1}$	$(1-\alpha)_{t+1}(\dot{q}_T - \dot{q}_{NT})_{t+2}$	•	•	$(1-\alpha)_{t+1}(\dot{q}_T - \dot{q}_{NT})_{T-1}$	$(1-\alpha)_{t+1}(\dot{q}_T - \dot{q}_{NT})_T$
$(1-\alpha)_{t+2}(\dot{q}_T - \dot{q}_{NT})_t$	$(1-\alpha)_{t+2}(\dot{q}_T - \dot{q}_{NT})_{t+1}$	$(1-\alpha)_{t+2}(\dot{q}_T - \dot{q}_{NT})_{t+2}$	•	•	$(1-\alpha)_{t+2}(\dot{q}_T - \dot{q}_{NT})_{T-1}$	$(1-\alpha)_{t+2}(\dot{q}_T - \dot{q}_{NT})_T$
$(1-\alpha)_{t+3}(\dot{q}_T - \dot{q}_{NT})_t$	$(1-\alpha)_{t+3}(\dot{q}_T - \dot{q}_{NT})_{t+1}$	$(1-\alpha)_{t+3}(\dot{q}_T - \dot{q}_{NT})_{t+2}$	•	•	$(1-\alpha)_{t+3}(\dot{q}_T - \dot{q}_{NT})_{T-1}$	$(1-\alpha)_{t+3}(\dot{q}_T - \dot{q}_{NT})_T$
•	•	•	•	•	•	•
•	•	•	•	•	•	•
•	•	•	•	•	•	•
$(1-\alpha)_{T-1}(\dot{q}_T - \dot{q}_{NT})_t$	$(1-\alpha)_{T-1}(\dot{q}_T - \dot{q}_{NT})_{t+1}$	$(1-\alpha)_{T-1}(\dot{q}_T - \dot{q}_{NT})_{t+2}$			$(1-\alpha)_{T-1}(\dot{q}_T - \dot{q}_{NT})_{T-1}$	$(1-\alpha)_{T-1}(\dot{q}_T - \dot{q}_{NT})_T$
$(1-\alpha)_T(\dot{q}_T - \dot{q}_{NT})_t$	$(1-\alpha)_T(\dot{q}_T - \dot{q}_{NT})_{t+1}$	$(1-\alpha)_T(\dot{q}_T - \dot{q}_{NT})_{t+2}$			$(1-\alpha)_T(\dot{q}_T - \dot{q}_{NT})_{T-1}$	$(1-\alpha)_T(\dot{q}_T - \dot{q}_{NT})_T$

Note that expression (2a) represents one fixed but arbitrary row of the matrix, while expression (2b) represents its principal diagonal (indicated by the shaded cells in the matrix). By contrast, expression (3) represents the entire matrix. The distinction between counting the diagonal, or one of the rows, and the full matrix illustrates the distinction between the short- and the long-term B-S approach.

Table 1 will be useful when in Section 5 we analyze how structural inflation drivers evolve. In particular, for visualizing how leading and lagging productivity growth differentials might impact on structural inflation.¹³ The terms to the left of the (shaded) principal diagonal lend themselves to the interpretation of *lags* in the above described sense. These are the terms of a sub-sum of (3), given by

$$4a) \quad \sum_{j=t+1}^T (1-\alpha)_j \sum_{i=t}^{T-1} (\dot{q}_T - \dot{q}_{NT})_i,$$

while the terms to the right of the principal diagonal are interpreted as *leads*, and are represented by a sub-sum of (3) given by

$$4b) \quad \sum_{j=t}^{T-1} (1-\alpha)_j \sum_{i=t+1}^T (\dot{q}_T - \dot{q}_{NT})_i$$

3. A long-run supply side approach to structural Inflation

The Scandinavian Model of Inflation incorporates the Balassa-Samuelson effect into a comprehensive long-run framework, where wage growth is equalized between sectors allowing the productivity growth

¹³ In an econometric analysis the weights assigned to the various matrix elements in computing the value of expression (3) for a given dataset are estimated, i.e. would be endogenous to the model.

differential to simultaneously impact the tradable and the non-tradable sector. The formation of wages is related to the productivity differential between sectors, and hence the B-S effect. The relationship between wages and the productivity differential comes about to maintain fixed income shares for both capital and labour. In the model, the demand side is implicitly suppressed, highlighting the supply side determinants of structural inflation.

Consider a small open economy, split into a tradable and a non-tradable sector along the lines of Lindbeck (1979), where labour and capital are used as inputs in both sectors of production. The two sectors differ when it comes to pricing, as purchasing power parity is assumed to govern pricing of tradable goods. In the non-tradable sector there is mark-up pricing, as prices are set in relation to unit labour costs. Labour is homogenous and factor income shares are fixed. This in basic constrains the model to the long run. Expressing all variables as rates of change, the structural approach to inflation reads

$$5) \quad \dot{P} = \dot{p}_w + \dot{e} + (1 - \alpha)[\dot{q}_T - \dot{q}_{NT}]$$

where (P) equals the domestic price index, (p_w) world market prices and (e) the exchange rate. In addition, productivity growth in the tradable (q_T) and in the non-tradable sector (q_{NT}) impact inflation, where the productivity growth differential is scaled down by the size of the non-tradable sector, $(1 - \alpha)$, measuring the share of aggregate output of the non-tradable sector. In equation 5) the last term represents structural inflation, i.e. $\dot{P}_{STR} = (1 - \alpha)[\dot{q}_T - \dot{q}_{NT}]$, as already introduced in equation 1.

This representation of structural inflation is common to both conventional B-S analysis and the Scandinavian Model of Inflation. For highlighting the distinction between conventional B-S analysis, and our extended version of the Scandinavian Model of Inflation, let us consider the impact on structural inflation of an increase in the productivity growth differential.

As it is only the difference in productivity growth between sectors that matters, we simplify the exposition by assuming that productivity growth in the non-tradable sector is zero $(\dot{q}_{NT} = 0)$. This makes the productivity growth differential equal to productivity growth in the tradable sector. Let us also assume that sector sizes are fixed in the short-run, motivated by the discussion in section 2. Now, the short-run productivity growth pass-through equals

$$7) \quad \frac{d\dot{P}_{STR}}{d\dot{q}_T} = (1 - \alpha) > 0$$

The short-run B-S effect is positive when the productivity growth differential increases. The extent of productivity growth pass-through is determined by the size of the non-tradable sector.

However, as discussed above, the short-term analysis must be extended when analysing long-term shifts. In particular, the fixed sector size assumption must be relaxed. This is what our extension of the Scandinavian Model of Inflation introduces. According to the B-S effect, structural inflation has two components: the productivity growth differential and how this productivity growth differential is passed through to inflation. Variations in structural inflation can now come from two sources: directly via changes in the productivity growth differential, and indirectly through variations in how the productivity growth differential is passed-through to inflation. While equation 7) takes into account the former of these two, the latter is ignored. By endogenising sector sizes, variations in productivity growth pass-through are also accounted for.

Thinking of sector sizes as a consequence of productivity growth differentials motivates our extension of the Scandinavian Model of Inflation: to define the relative size of the tradable sector as an increasing function of the productivity growth differential.¹⁴

¹⁴ It is assumed that $\alpha_t = \alpha(\dot{q}_T)$ is continuous and differentiable.

8) $\alpha_t = \alpha(\dot{q}_T)$ where $\alpha'(\dot{q}_T) > 0$

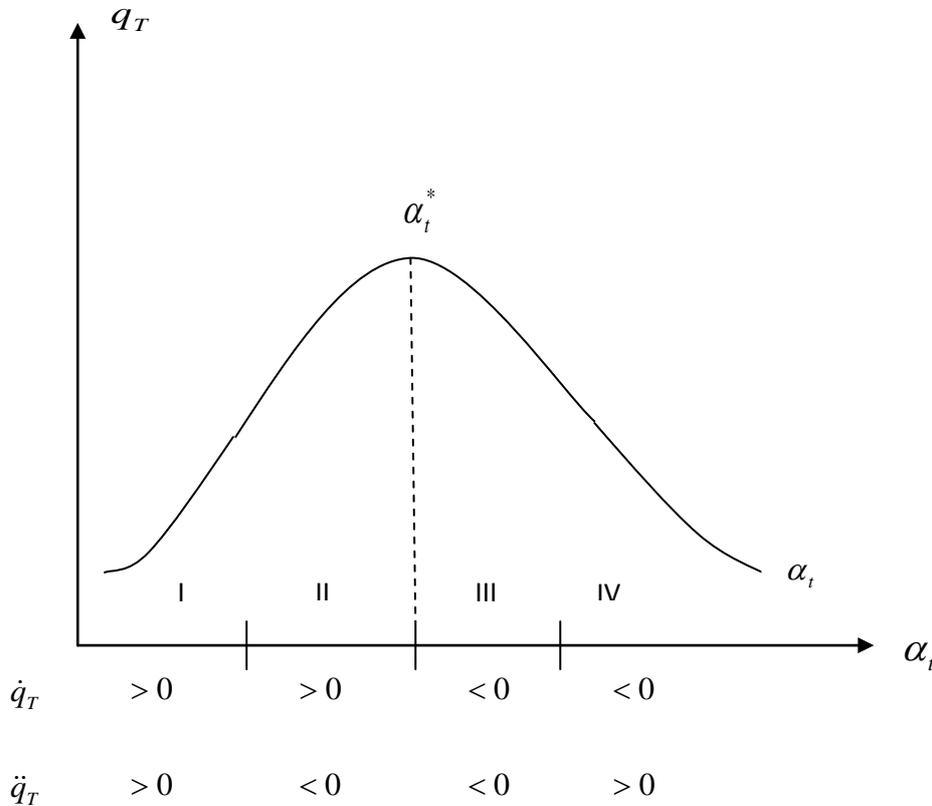
The positive relationship between the productivity growth differential and the tradable sector implies a negative relationship between the productivity growth differential and the non-tradable sector. This defines an inverse relationship between the productivity growth differential and the productivity growth pass-through. Hence, even if the productivity growth differential decreases, structural inflation can still increase. This as long as the sector size response is substantial, and the increase in productivity growth pass-through more than outweighs the reduction in the productivity growth differential. Hence, the long-run approach adds complexity to the analysis of structural inflation and the B-S effect.

The combined effect on structural inflation when sector sizes are endogenous is analysed by Borgersen and King (2009), distinguishing between a productivity effect (PE) and a size effect (SE). Whereas the former incorporates the direct effect on structural inflation from the productivity growth differential, the latter captures the indirect effect following the sector size response and the changing productivity growth pass-through.¹⁵ The combined effect on structural inflation is:

9)
$$\frac{d\dot{P}_{STR}}{d\dot{q}_T} = \left(\underbrace{(1-\alpha)\ddot{q}_T}_{PE} - \underbrace{(\dot{q}_T)\alpha'(\dot{q}_T)\ddot{q}_T}_{SE} \right)$$

Figure 1 gives a schematic relationship between a number of different productivity measures in the tradable sector and the sector size. The size of the tradable sector is measured on the horizontal axis, while the vertical axis measures tradable sector productivity. The graph shows the relation between the two, and illustrates the relationship between the size of the tradable sector and the productivity growth information set (highlighted below the first axes).

Figure 1: The relationship between the size of the tradable sector and its productivity measures



¹⁵ See Borgersen and King (2009) for comparative statics.

The interpretation of figure 1 can briefly be described as follows: When productivity is at its peak, the tradable sector is close to full resource utilization. When the tradable sector is smaller than its optimal size (for instance in regime ii), the positive productivity growth will make the sector expand. When tradable sector size is above its optimal value, the negative productivity growth prompts a contraction. In the regimes II and III, where the acceleration of tradable sector productivity growth decreases, the size of the tradable sector adjust towards full capital utilisation. In regime II, where the tradable sector increases (and the non-tradable sector decreases), the increase in the productivity growth differential stimulating structural inflation, is counteracted by the reduction in productivity growth pass-through. In regime iii on the other hand, where the tradable sector decreases, the reduction in the productivity growth differential is accompanied by an increase in the non-tradable sector, i.e. in the productivity growth pass-through.

The endogenous sector size allows us to address the combined impact on structural inflation following an increased productivity growth differential, which can be either positive or negative. By

manipulating equation 9) the conditions for when $\frac{d\dot{P}_{STR}}{d\dot{q}_T} > 0$ can be expressed as:

$$10a) \quad El_{\alpha} \dot{q}_T > \left(\frac{1-\alpha}{\alpha} \right) \quad \text{when} \quad (\ddot{q}_T < 0)$$

$$10b) \quad El_{\alpha} \dot{q}_T < \left(\frac{1-\alpha}{\alpha} \right) \quad \text{when} \quad (\ddot{q}_T > 0)$$

where $El_{\alpha} \dot{q}_T = \left(\frac{\alpha'(\dot{q}_T)}{\alpha} \dot{q}_T \right)$ is the sector size elasticity, measuring how the distribution of value added

between sectors is affected by a one percent increase in the productivity growth differential. The conditions for when an increased productivity growth differential increases structural inflation, depends on the relationship between the sector size elasticity and the prevailing distribution of value added, but varies according to acceleration of the productivity growth differential.

In the centre of figure 1, structural inflation will increase if the sector size elasticity exceeds the existing distribution of value added.¹⁶ In the wings, the sector size elasticity has to be smaller than the prevailing distribution of value added for structural inflation to increase. Stated differently, in the centre a higher productivity growth differential will increase structural inflation when the size effect exceeds the productivity effect. When the sector size elasticity exceeds the existing distribution of value added, the higher productivity growth pass-through will compensate for the reduced productivity growth differential. In the wings on the other hand, where the sector size elasticity is smaller than the prevailing distribution of value added, the reduced pass-through has to be accompanied by an increased productivity growth differential for structural inflation to increase.

When comparing the short-run B-S analysis to our long-run B-S approach, some interesting observations come about: While in the short-run framework the conditions for inflationary pressure is only exerted in regimes I and II of figure 1 (see equation 7), it can be associated with all four regimes in the long-run (see equations 10a and 10b). This illustrates why the short-run B-S approach might understate the B-S effect, being susceptible to erratic year-on-year productivity growth differentials between sectors. The endogenous productivity growth pass-through gives a more differentiated understanding of how productivity growth differentials impact on structural inflation. That is, although the short-run B-S effect is negative the long-run B-S effect can still be positive.

¹⁶ The conditions for when structural inflation decreases are given by conditions (10a) and (10b), but now the inequalities are reversed.

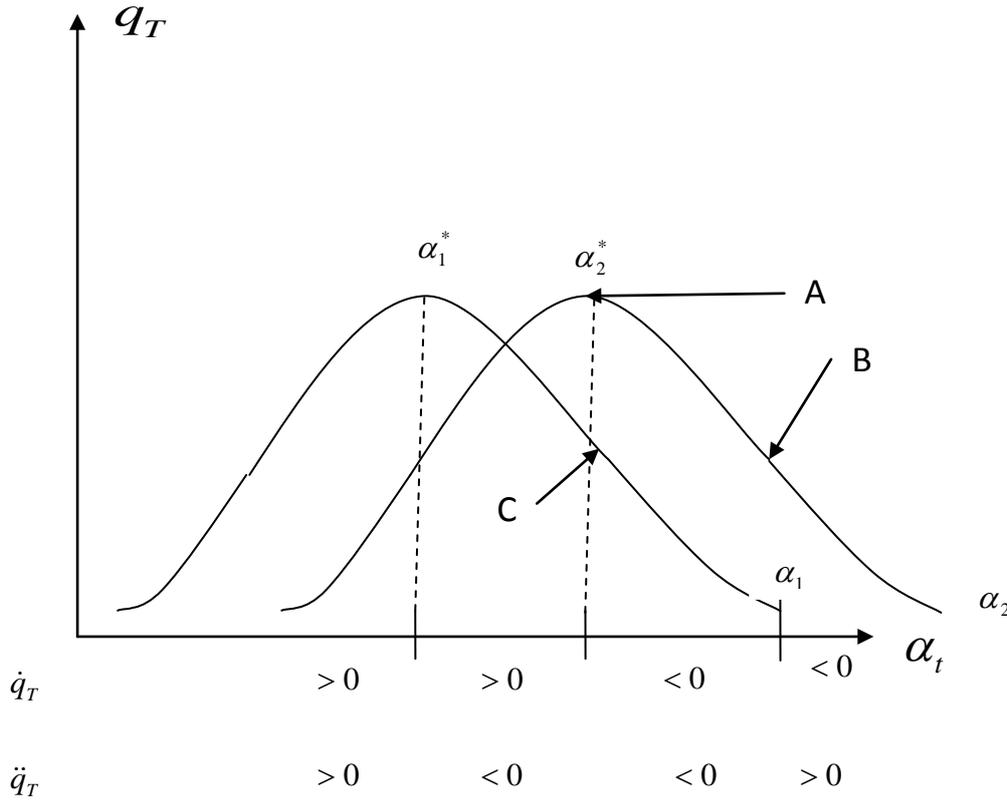
4. Reallocation and restructuring

While the short-term B-S effect is associated with fixed sector sizes, the long-run approach in Section 3 allows for changes in sector sizes, but keeps the optimal distribution of value added fixed. According to the reasoning in Section 2, about the different version of structural inflation applied in the B-S analysis, the short-run B-S effect where sector sizes are fixed is represented by expression (2a). Likewise, expression (2b), allowing for changes in sector sizes, can be associated with our long-run B-S effect above. Still, the reasoning regarding structural inflation should also allow for potential shifts in the optimal distribution of value added. Transition is, as highlighted by Blanchard (1997) and described earlier, associated with changes in the optimal distribution of value added between sectors over time. More specific, *transition* is defined as a relative decrease (increase) in the tradable (non-tradable) sectors optimal share of value added as the economy matures. Hence, in addition to the *reallocation* effect captured by equation (2b), we also allow for a more fundamental structural shift, referred to as *restructuring*. These latter shifts are associated with changes in optimal sector sizes. While reallocation implies movements along one particular curve in figure 2 below, restructuring encompasses shifts to another of the family of curves.

Both reallocation and restructuring are related to changes in the productivity growth differential. That is, increased productivity in a sector increases profits and rents, which act as a signal for shifting of resources into the sector, through changes in relative prices. However, while reallocation is characterised by expansions - or contractions - of resources highly sensitive to the current productivity growth differential, the shifting of resources accompanying restructuring requires something more than just instantaneous stimulus. It depends on the underlying momentum in the productivity growth differential, incorporating both current-, past-, and expected future productivity growth differentials. Hence, restructuring is related to the measure of structural inflation given by expression 3.

Figure 2 shows two of a family of curves, which in their entirety trace out a country's transition trajectory, including both reallocation and restructuring. As transition is defined as changes in the distribution of value added towards the non tradable sector, the closer to the origin a curve is located, the more mature the economy. The dynamics of restructuring are linked to reallocation. Consider an economy initially at point B (equivalent with regime iii in figure 1), where resources are not optimised, given the optimal distribution of value added (α_2^*) . Assuming that condition 10a) holds structural inflation increases.

Figure 2: Reallocation and restructuring. The productivity information set is related to (α_2)



At point B the deflationary impact on structural inflation accompanying the negative productivity growth differential is dominated by the increased productivity growth pass-through. When the economy moves from point B towards point A, structural inflation increases. As the reallocation process moves the economy towards point A, the (α_2) curve “flattens out”. Once the sector size elasticity approaches the prevailing distribution of value added, the productivity growth differential becomes incapable of inducing further volume responses. Additional reallocations can now no longer translate into productivity gains. The reallocation process is characterised by a negative productivity growth differential, which stimulates the non-tradable sector. Contrary to the falling productivity growth differential, the rising productivity growth pass-through stimulates inflation. At point A the productivity growth differential approaches zero, and the productivity growth pass-through dominates the impact on structural inflation. The increased impact of the productivity growth pass-through builds up cumulative structural inflation. When structural inflation increases, and (eventually) reaches a critical value K , it challenges the existing optimal sector structure. Now restructuring changes the optimal sector sizes, i.e. there is a shift from (α_2^*) to (α_1^*) , and the economy jumps from point A to point C, where a new process of reallocation starts over.

The condition for shifting between curves, illustrating restructuring, can, where (q_T^C) represents the cumulative average productivity growth differential, and $(\hat{\alpha}^*)$ denotes a fixed but arbitrary (α^*) , be denoted as follows:

$$11) \quad \alpha_t^* = \begin{cases} \hat{\alpha}_{t-1}^* & \text{iff } \frac{d\dot{P}_{STR}}{dq_T^C} < K \\ \hat{\alpha}_t^* & \text{iff } \frac{d\dot{P}_{STR}}{dq_T^C} \geq K \end{cases} \quad \text{where } (\hat{\alpha}_t^* < \hat{\alpha}_{t-1}^*) \text{ and } (K \geq 0)$$

When the cumulative average productivity growth differential makes structural inflation exceed a given threshold (K), the optimal distribution of value added changes. Restructuring comes about when the

benefits from reallocation have been exhausted. The condition for restructuring and transition can alternatively, when applying equation 10a), be expressed as:

$$12) \quad \frac{d\dot{P}_{STR}}{d\dot{q}_T^C} \geq K \quad \text{that is when} \quad El_\alpha \dot{q}_T \geq \left(\frac{1-\alpha}{\alpha} \right) - \frac{K}{\alpha \ddot{q}_T} \quad (K \geq 0)$$

That is, when the sector size elasticity exceeds a threshold defined by the existing distribution of value added, adjusted for the K-component, restructuring comes about.

The analysis points to two interlinked phases of transition, both related to productivity growth developments in the tradable and in the non-tradable sector. This lends itself to the interpretation that reallocation is associated with medium-term processes, restructuring describes longer-term developments. When the reallocation gains have been exhausted the energies from the productivity growth differential emerge as an accelerator of structural inflation. When structural inflation reaches an intensity level K, the reallocation process eventually stimulates the restructuring dynamics.

5. Structural inflation drivers

Given the discussion in section 2 we allow for an interpretation of K in order to discuss how structural inflation drivers might vary over time and between countries at different stages of transition. Let us start out by endogenising K, and assume that it can be represented as a function (g) of the long run B-S effect, that is the cumulative productivity growth differential

$$13) \quad K = g \left[\sum_{j=t}^T (1-\alpha)_j \sum_{i=t}^T (\dot{q}_T - \dot{q}_{NT})_i \right]$$

The conditions for long-term transition is then related to the difference between the sector size elasticity, the existing distribution of value added between sectors, and K, measuring the underlying trend in the productivity growth differential. For considering the extreme cases regarding the relationship between the productivity growth differential and transition let us assume that the g-function takes the following form:

$$14) \quad K = \left[\sum_{j=t}^T (1-\alpha)_j \sum_{i=t}^T (\dot{q}_T - \dot{q}_{NT})_i \right] - \left[\sum_{j=t}^T (1-\alpha)_j (q_T - q_{NT})_j \right]$$

That is the full matrix minus the principal diagonal, or stated differently the cumulative structural inflation less the year-on-year derived structural inflation. When excluding $K < 0$, three possible cases emerge:

Case 1: First, in the absence of lead- and lag effects between structural inflation and the productivity growth differential $K=0$, and the condition for transition will equal condition (8a). In this case our long run B-S measure of structural inflation and that of the conventional B-S analysis (short-term B-S) coincide.

Case 2: If on the other hand $K > 0$, the conditions for long-term transition are harder to satisfy. That is, not under all circumstances is structural inflation associated with long-term transition. If we consider an established transition economy, one where transition from a planned to a market led economy is well under way, and the productivity growth differential for a long period of time has been favourable for transition, then the lag effect between past productivity growth differentials and structural inflation is strong. If expectations of continued future transition suddenly vanish the K function would only consist of the terms to

the left of the principal diagonal. Structural inflation is now completely driven by the lag-effect, and the K-function equals

$$15) \quad K = \left[\sum_{j=t+1}^T (1-\alpha)_j \sum_{i=t}^{T-1} (\dot{q}_T - \dot{q}_{NT})_i \right] - \left[\sum_{j=t}^T (1-\alpha)_j (q_T - q_{NT})_j \right]$$

Case 3: If $K > 0$ and we consider an economy in its initial phases of transition where the government announces a policy shift, emphasising transition and boosting expectations about future productivity growth developments, K would only consist of the terms to the right of the principal diagonal, that is

$$16) \quad K = \left[\sum_{j=t}^{T-1} (1-\alpha)_j \sum_{i=t+1}^T (\dot{q}_T - \dot{q}_{NT})_i \right] - \left[\sum_{j=t}^T (1-\alpha)_j (q_T - q_{NT})_j \right]$$

All in all, the condition for when structural inflation will be high enough to generate transition varies both between countries and over periods. The three cases outlined above are extremes, in the sense that they display pure lead- or pure lag effects between the productivity growth differential and structural inflation, or complete absence of such effects. In reality these extreme cases are unlikely to be observed, as a mix of both lead and lags can be expected. Applying econometric tools to country data could assign weights to the cells in the matrix and allow us to classify countries according to their stage on the transition trajectory. Anyhow, context specific analyses are necessary to predict which rate of structural inflation that will induce long-term transition.

6. Summary and discussion

This paper questions the conventional framework for analyzing structural inflation and the B-S effect, and suggests an alternative based on an extension to the Scandinavian Model of Inflation. The theoretical foundations of the B-S effect are addressed, leaving empirical applications for future research.

In comparison to conventional B-S analysis, the Scandinavian Model of Inflation is more decidedly anchored in the supply side, and with a more firm long-term focus. We extend this framework for structural inflation by endogenising the relationship between sector sizes and the productivity growth differential, the two main components of the B-S model. All in all, this allows us to address three main shortcomings of conventional B-S analysis: the demand side channel, the short-term focus, and the lack of dependence between the two main factors impacting on structural inflation.

While typical B-S analysis computes sectoral shares based on CPI (a demand side statistic), a supply side emphasis will typically make GDP a preferred choice. In transition economies the CPI based measures have been shown to weaken the B-S effect. Focusing on the demand side and downplaying the supply side, seems a questionable strategy for analysing structural inflation. Rather, the part of the economy where structural factors reside should be the key object of analysis.

A supply side emphasis immediately leads the way for a long-run perspective, as structural shifts residing on the supply side are long-term processes. This perspective implies that not only contemporaneous values of the productivity growth differential should be taken into account when analyzing structural inflation.

We introduce the concept of cumulative productivity growth differential as a long-run driver of structural inflation and the B-S effect. In our terminology, “counting the entire data-matrix, instead of just its principal diagonal, or one of its rows”, comes about as a way of accounting for how productivity growth differences between sectors impact on inflation. This allows rather arbitrary values of the year-on-year-

productivity growth differential- complicating conventional B-S estimates - to be replaced by cumulative differentials, better suited for analyzing long-run supply side driven structural shifts.

The long-run focus also provides additional insights on the B-S effect from the endogenous relationship between sector sizes and the productivity growth differential. The lack of dependence between the two is shown to hamper short-term B-S analysis. In our long-run B-S approach a reduced productivity growth differential can be compensated by an increased productivity growth pass-through, or vice versa. Hence, the long-run B-S approach shows that the link between productivity growth and structural inflation is more complex than what the short-term approach leads us to believe.

Focusing on the cumulative productivity growth differential implies that we allow structural inflation and the B-S effect to be influenced by both leads- and lags in the productivity growth differential. While the lagging effects can be argued strong in mature transition economies, the leads might be dominant among newcomers. The relative strength of the different inflation drivers can be used to classify countries along the transition trajectory.

Augmenting the short-term B-S approach even allows us to separate between different types of structural shifts. Both reallocation and restructuring are long-run structural shifts driven by the productivity growth differential between sectors. The relation between the two illustrates the complexity of the transition process. Restructuring comes about as the reallocation process loses steam, and structural inflation escalates. In turn, the shifts brought about by restructuring create new opportunities for reallocation to resume.

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