PRODUCTION SHARING AND BUSINESS CYCLE SYNCHRONIZATION IN THE ACCESSION COUNTRIES

LINDA L. TESAR
UNIVERSITY OF MICHIGAN AND NBER

THIS DRAFT: MAY 2006

COMMENTS ARE WELCOME

ABSTRACT

This paper provides a quantitative assessment of the role of trade in the transmission of business cycles within and between the regions of East and West Europe. The model allows for trade in intermediate inputs that are substitutes in production and for nearshoring, in which intermediate inputs from East and West are complements. The model is calibrated to data on aggregate and bilateral trade flow, relative country sizes and the extent of nearshoring. The model suggests that expanded East-West trade will produce positive output co-movements within Europe. However, the two types of trade also produce very different dynamics for consumption and labor supply. Thus, one's view of whether trade makes business cycles "more similar" across Europe or not depends both on the nature of trade and on the metric one uses to assess business cycle synchronization.

I am grateful to Jeff Frankel, for suggesting this idea, and to Yuriy Gorodnichenko and Jing Zhang for their helpful comments and suggestions. The usual disclaimer applies. Correspondence: ltesar@umich.edu or Linda Tesar, Department of Economics, University of Michigan, 611 Tappan St, Ann Arbor, MI 48109.

1. Introduction

One of the issues confronting Europe is the proposed expansion of the eurozone to include a number of countries in Central and Eastern Europe (CEECs). The potential benefits of expanding the euro area include greater trade linkages between East and West Europe and, for the euro-adopting countries, the elimination of exchange rate risk and the stabilization of prices. The potential costs of euro adoption, however, are the loss of independent monetary policy in the CEECs, and for the core EU countries, potential pressure on EU policy to meet the needs of a larger and more diverse set of constituents.

According to Mundell's (1961) classic argument, a region constitutes an optimum currency area if the benefits of sharing a currency exceed the costs. Two types of yardsticks are often applied to assess the cost-benefit ratio of a common currency. The first is whether countries experience similar business cycle fluctuations. To the extent countries are exposed to the same shocks, the argument goes, the easier it is for a shared monetary authority to accommodate those shocks. A second, and related, metric is the extent to which goods and factor markets are flexible enough to respond to shocks, reducing the need for adjustments in monetary policy.

This paper focuses on the first of these criteria. In particular, the purpose of this paper is to quantitatively assess the role of trade in the transmission of business cycles within and between the regions of East and West Europe. In theory, the impact of trade flows on business cycles is ambiguous. If trade induces countries to specialize according to comparative advantage, increased trade could result in more asynchronous cycles. On the other hand, if trade involves vertically integrated networks, in which production chains extend across national borders, trade could lead to more correlated cycles. Thus it is not obvious whether increased trade linkages between East and West will generate more correlated cycles, and therefore reinforce efforts to coordinate monetary policy, or whether trade could cause business cycles to diverge.

To study this issue I develop a framework that captures trading patterns in Europe. The model is calibrated to data in order to obtain a quantitative assessment of the impact of increased trade on business cycle transmission. I extend the basic international business cycle model proposed by Backus, Kehoe and Kydland (1995), henceforth BKK, to a multi-country setting. As in BKK, trade occurs at the level of intermediate goods, and business cycles are driven by shocks to total factor productivity that change relative marginal costs across countries. In the standard BKK set up, an aggregate shock to productivity lowers the relative marginal cost of production in the home country. This induces firms and households in both countries to substitute toward the lower price good, resulting in a negative transmission of the business cycle from the home to the

foreign country. In recent work, Burstein, Kurz and Tesar (2005) show that when intermediate inputs are complements in production, as would be the case if firms engage in production sharing across international borders, a decline in the relative marginal cost in the home country will increase demand for the intermediate good from other countries in the production chain, leading to a positive transmission of the business cycle. Therefore, depending on the nature of a country's dependence on intermediate inputs, the model can generate positive or negative co-movements depending on the nature of trade. [1]

Section 2 documents the volume of trade, FDI flows and production sharing in a sample of four West European and four East European countries. These data are used in the calibration of the model, so that the model approximates the direction and volume of trade and trade's share of economic activity in a "typical" West and East European country. The data suggest that trade with West Europe accounts for the lion's share of East European exports and imports and that East European trade in manufactured goods is substantially larger than local manufacturing value added. The paper also presents evidence that trade in manufactured goods for further processing accounts for a significant share of total East-West trade flow.

The theoretical model used to describe trade and business cycle transmission is developed in Section 3. The model assumes that there are two kinds of trade between East and West – trade in intermediate goods that are substitutes ("standard" trade flow) and trade in intermediate goods that are substitutes (production sharing). West-West trade involves only standard trade flow. Production of intermediate goods in each country is subject to a country-specific productivity shock. A calibrated version of the model produces correlations within and between East-West regions under different scenarios. Given the observed volume of trade and the extent of production sharing, the model suggests that East-West trade generates positive bilateral output correlations between East and West Europe of about 0.13. If the creation of a common currency area increases the volume of East-West trade by fifty percent – a modest increase relative to the that predicted by Rose (2000) -- the model predicts an increase in the average bilateral output correlation for all of Europe from 0.06 to 0.32.

[1] Other papers that have examined the role of substitutability of intermediate inputs on business cycles include Ambler, S., E. Cardia and C. Zimmerman (2002), Heathcote and Perri (2003) and Kose and Yi (2006).

2. Trade and European business cycle fluctuations.

A large number of studies have examined the synchronization of business cycles within and between the countries of East and West Europe, using a number of different methodologies and datasets.[2] Fidrmuc and Korhonen (2004) provide a "meta-analysis" of business cycle correlations, compiling results from a large number of papers. While there is some evidence that business cycle co-movements between a subset of East European countries and the core EU countries have increased over time, the shortness of the sample raises issues of robustness. Since the process of integration between East and West is still underway, it is difficult to use past data to assess the impact of trade and other market linkages on business cycles. Adding to the difficulty is the problem of disentangling transition dynamics after the collapse of the Soviet Union from the more traditional notion of a cycle as a deviation from a long run trend. The perspective adopted here is to take information on business cycles and trade in the two regions in the 1990-2005 period as a snapshot of the current situation, and to ask whether increased trade flows could have an important impact on cycles going forward. In that spirit, Table 1 provides cross-country correlations between output, total industrial production, industrial production of manufactures and investment for eight European countries, with the length of the time series varying depending on data availability. The four EU countries are Austria, France, Germany and Italy, chosen for their large size within the EU and for the extent of their trade linkages with Eastern Europe. The four East European countries include the Czech Republic, Hungary, Poland and Slovakia, countries that have the largest trading relationships with Western Europe and are the largest recipients of cumulated FDI inflows from the West. All data are quarterly, in real terms, seasonally adjusted and detrended using the HP filter. At the bottom of each panel is the average of the bilateral correlations of the four West European countries, the four East European countries, the average bilateral correlation across the two regions and the average correlation between each of the East European countries and the EU aggregate.

Starting with the top panel, the data indicate that GDP correlations within Western Europe are large and positive, ranging between 0.52 and 0.78, with an average of 0.69. Correlations within Eastern Europe are also positive but have a wider range, from 0.15 between Poland and the Czech Republic, to 0.81 between Hungary and the Czech Republic. The average within CEEC correlation is 0.32. The lowest correlations are between the East and the West, with

[2] To list just a subset of these papers: Artis, Marcellino and Proietti (2003), Boone and Maurel (1998), Darvas and Szapary (2003), Fidrmuc and Korhonen (2003), Suppel (2003).

an average cross-region correlation of 0.05.[3] The model below will use the correlations in Table 1 as a starting point for the numerical experiments, rather than as a target for "matching moments."

Panels B and C report the cross-country correlations for total industrial production and industrial production in manufacturing. The cross-country correlations of industrial production are somewhat larger than for aggregate GDP, but the ranking remains the same, with the largest correlations between West European countries, somewhat lower correlations among the CEECs and the lowest co-movements between the East and West. Panel D of table 1 repeats the exercise for investment. Interestingly, investment is positively correlated in the sample of West European countries. In the numerical examples in Section 5, I will assume productivity shocks are positively correlated in the West European countries, consistent with the observed co-movements in investment.[4]

Turning to the trade data, Table 2 reports bilateral trade flows for the eight countries in the sample for the 2000-2004 period. Panel A shows imports from (other) West European countries, from (other) East European countries, North America, Asia and other regions. In general, West European countries tend to trade with other West European countries while East European countries tend to trade with West Europe and trade little with each other. Looking down the first column of the table, the data suggest that trade with other West European countries accounts for 50 -- 66 of the total volume of imports of the four West European countries in the sample, and accounts for 53 -- 62 percent of their total volume of exports. East European countries tend to import about 49 -- 61 percent of their imports from West Europe, and export a slightly larger share to West Europe. On average, trade with East Europe accounts for 6 percent of the trade of West European countries. Trade with other East European countries accounts for about ten percent of total East European trade. Trade with North American accounts for less than ten percent of trade for both East and West European countries, while trade with Asia accounts for between 5 and 25 percent of trade flows. The simulation model will focus on the intra-European trade flows and will abstract from flows to North America and Asia.

The impact of trade on the transmission of business cycles depends not just on the direction of trade, but also on the importance of trade in total economic activity. The first panel in Table 3 shows trade (measured as the sum of exports and imports) as a share of GDP. In 2004, trade accounted for 54 to 110 percent of GDP in the four West European countries, and a larger

[3] GDP correlations are obviously only one measure of business cycle synchronization. See Fidrmuc and Korhonen (2004) and Darvas and Szapary (2004) for a discussion of alternative measures of business cycle co-movements in Europe.

[4] In standard open-economy business cycle models, trade induces a large negative cross-country correlation in investment unless shocks are strongly positively correlated. As will be seen in Section 5, the assumption of a 0.5 correlation in the innovations to productivity produces a weakly negative investment correlations.

share ranging from 126 to 246 percent of GDP in the sample of East European countries. In both regions, the trade share has risen since 1990, and the rate of increase is generally larger in East Europe. Trade in manufactured goods is an even larger share of manufacturing value added, with ratios that exceed five in the East European countries. The high volume of trade in manufactures against a relatively low base of manufacturing value added is suggestive that trade involves production sharing, where intermediate goods are shipped internationally and value is added at different stages of the production process. Panel C shows that the share of the manufacturing sector relative to GDP is about the same size across the two regions, so the key difference between East and West Europe is the high volume of trade in manufactured goods in the East.

The impact of offshoring labor-intensive activities to low-wage countries has been widely documented in the trade literature (see Hanson, G., R. Mataloni, and M. Slaughter (2005), Hummels, Ishii and Yi (2001), and Yi, K. (2003)). A new term – "nearshoring" – has been coined to describe the offshoring activities of West European firms in the former Soviet states. While wages in East Europe are not as low as those in Asia, transportation costs are dramatically lower, the East European labor force is better educated, and there are important cultural and institutional ties between East and West Europe. A recent article in *The Economist* is illustrative of the decision to nearshore. In an interview, a broker in the textile industry notes that production in East Europe is particularly advantageous in the "fast fashion" industry, where garments must get to the market quickly before consumer tastes change. While the manufacturing cost per article of clothing is higher in East Europe than in China, the time from ordering to delivery is reduced from months to weeks. Thus nearshoring is particularly important in industries where brand names matter and product life cycles are short. Currently, about 20 percent of West European textile imports are produced in East Europe (*The Economist*, 2005).

It is difficult to obtain a precise estimate of the magnitude of nearshoring activities in East Europe but the volume of FDI flows to East Europe and transactions between multinationals and their affiliates in East Europe provide some clues. Figure 1 shows the flow of FDI into the four East European countries in the sample over the 1985 to 2004 period. FDI picked up after the fall of the Soviet Union with the privatization of state-owned enterprises and as restrictions on foreign ownership were lifted. Flows to Hungary (in terms of $US) peaked in 1993, while flows to the Czech Republic, Poland and Slovakia peaked in the late 1990s or in 2000. Figure 2 illustrates the number of foreign merger and acquisition transactions in the Czech Republic, Hungary and Poland. Again, transactions in Hungary tended to peak somewhat earlier than in the Czech Republic and Poland. Table 4 shows FDI inflows over the 2000-2004 period decomposed

by country of the investor. The majority of FDI inflows in East Europe originate in the EU. Germany, in particular, is a major source of foreign direct investment in Hungary and Slovakia.

Of course, the important issue for business cycle transmission is not whether multinationals are present in East Europe – they are present everywhere in Europe -- but whether their activities involve production sharing. The first three rows of Table 5 provide information on the share of multinational activity as a fraction of domestic economic activity. Value added of foreign affiliates as a percent of manufacturing value (row A) ranges from 26 percent in Czech Republic to an astounding 70 percent in Hungary.[5] The employment share of foreign affiliates in manufacturing ranges (row B) ranges from 19 percent in Poland to 47 percent in Hungary. Finally, turnover (i.e. sales) of foreign affiliates as a share of total turnover in the manufacturing sector (row C) ranges from 35 percent in Poland to 73 percent in the Czech Republic and Hungary. These figures suggest that the activity of foreign affiliates constitutes a sizable share of total manufacturing activity in East Europe.

The last two rows in Table 5 provide information on trade in intermediate inputs between foreign affiliates in East Europe and their parents in Austria and Germany.[6] Unfortunately, this data is not available for transactions by other parent firms in West Europe, but the data from Austria and Germany are certainly indicative of a significant volume of production sharing. Row D shows the volume of intermediate inputs shipped from a parent firm to its East European affiliate as a fraction of total exports. Fully 20 to 46 percent of Austrian exports to East Europe are intermediate inputs shipped to their East European affiliates for further processing. The figures are slightly smaller for Germany, ranging from 7 percent of total exports to the Czech Republic to 34 percent to Slovakia. Row E captures the flow of goods making the return trip to Austria and Germany, again as a fraction of total imports from each East European country. Note that not all production sharing is undertaken by multinationals in conjunction with their foreign affiliates. This activity may be subcontracted out to enterprises not under the control of the contracting firm.[7] Thus, the figures in Table 5 are likely to be a lower bound on the extent of nearshoring in East Europe.

[5] The OECD is currently in the process of creating a database on the activities of foreign affiliates (FATS – foreign affiliate trade statistics). Data for some countries is available in Measuring Globalisation: The role of multinationals in OECD economies, though the tables in the volume contain as many missing values as data.

[6] The data in rows D and E are based on a survey of Austrian and German multinationals with operations in East Europe. For details of the survey and how the ratios reported in Table 5 are constructed, see Marin (2005).

[7] For an analysis of outsourcing and control rights, see Feenstra and Hanson (2005).

A critical parameter in the numerical experiments below is the amount of local value added contributed by the East European country in the production sharing sector. The data in Table 5 can be used to back out an estimate of this parameter. The numerator in Row 5 is the value of the good shipped back to the West European parent, while the numerator in Row 4 is the value of the intermediate inputs shipped from parent to affiliate for further processing. Provided the denominators (exports to and from East Europe are roughly balanced – which is a close approximation to the data), the ratio of Row 4 to Row 5 is the fraction of local content. This fraction is roughly 0.5 (excluding the "1.36" entry, which is due to measurement error in Austrian sales to Hungarian affiliates – see the footnotes to the table and Marin (2005)). The figure 0.5 will be used in the calibration exercises below.[8]

3. Benchmark model

The model used to study business cycles in West and East Europe follows the framework set up in Burstein, Kurz and Tesar (2005). The model includes four countries, two West European countries, denoted 1 and 2, and two East European countries, denoted 3 and 4. Consistent with the bilateral trade data in Table 2, I assume that the West European countries engage in trade with each other, and each West European country has a key trading partner in the East (1 with 3 and 2 with 4). To keep the model relatively simple, I make the extreme assumption that there is no trade between Eastern European countries, or between a West European country and the other East European country (for example, Germany trades with Austria and with the Czech Republic but not with Hungary, and Austria trades with Germany and Hungary but not with the Czech Republic).[9] Countries are indexed by $i=1,2....,4$. [10] Each country i has a population of L_i

[8] Pavlinek (2005) provides a discussion of the expansion of automobile production in East Europe targeted for the West European consumer market. Estimates of the local content in various auto plants across East Europe range from 5 percent to 70 percent.

[9] The effect of allowing more extensive trade channels, such as East-East trade or cross East-West trade, is difficult to predict. Given country specific shocks, the additional channels would increase opportunities for substitution across different types of inputs. This could weaken or strengthen the transmission mechanism depending on the assumed elasticities.

[10] Note that the location of production and the direction of trade are exogenous to the model, abstracting from the issues of why firms locate where they do and why production sharing occurs where it occurs. While these are interesting questions, the focus here is on the behavior of firms at business cycle frequencies where the location of plant and equipment is already established and the firm's decision is the optimal combination of factor inputs and the amount to produce given relative prices. For a treatment of the impact of outsourcing on the location of production and the firm's decision at the extensive and intensive margin, see Bergin, Hanson and Feenstra (2005).

individuals. Countries 1 and 2 are symmetric, as well as countries 3 and 4. Preferences of the representative agent in country i are characterized by an expected utility function of the form:

$$U_i = \max E_0 \sum_{t=0}^{\infty} \beta^t u(c_{it}, 1 - n_{it})$$

where c_i and n_i denote per capita consumption and employment in country i, and the specific form of period utility is $u(c, 1-n) = \frac{1}{1-\sigma}\left[c^{\mu}(1-n)^{1-\mu}\right]^{1-\sigma}$.

Each country produces an intermediate good z_i using inputs of domestic labor n_i and capital k_i. The intermediate goods sector is subject to a country-specific shock to productivity A_i. The production function has constant returns to scale, and is given by:

$$z_{it} = A_i e^{s_{it}} (n_{it})^{\alpha} (k_{it})^{1-\alpha}.$$

The vector of aggregate productivity shocks $s_t = (s_{1t}, s_{2t}, s_{3t}, s_{4t})$ follows the process $s_{t+1} = Ps_t + \varepsilon_{t+1}$, where ε_t is distributed normally and independently over time, with mean 0 and variance Σ.

International trade occurs at the level of the intermediate good. Figure 3 provides a diagram of the location of production and the flow of trade between countries described in the equations below. Local and imported intermediate goods can be combined to produce two different types of final goods, x and v. The asymmetric impact of trade on business cycles is due to an assumption about the technology used to create these two goods. I assume that good x is not produced in a vertically integrated production chain, and that firms can readily substitute between local and foreign inputs in response to changes in technology and relative prices. Specifically, production of good x_i combines local and imported intermediate goods according to the following Armington aggregator:

$$x_{1t} = \left[\theta_1^{1-\rho}(x_{11t})^{\rho} + (1-\theta_1)^{1-\rho}(x_{12t})^{\rho}\right]^{\frac{1}{\rho}}$$

$$x_{2t} = \left[\theta_1^{1-\rho}(x_{22t})^{\rho} + (1-\theta_1)^{1-\rho}(x_{21t})^{\rho}\right]^{\frac{1}{\rho}}$$

$$x_{3t} = \left[\theta_3^{1-\rho}(x_{33t})^{\rho} + (1-\theta_3)^{1-\rho}(x_{31t})^{\rho}\right]^{\frac{1}{\rho}}$$

$$x_{4t} = \left[\theta_3^{1-\rho}(x_{44t})^{\rho} + (1-\theta_3)^{1-\rho}(x_{42t})^{\rho}\right]^{\frac{1}{\rho}}$$

The first subscript denotes the location of production, and the second subscript the input's country of origin (i.e. x_{12} is the intermediate input from country 2 used in country 1's production). In the numerical experiments below the elasticity of substitution, 1/(1-ρ), between inputs in this sector will be set relatively high reflecting the assumption that foreign and domestic inputs are close substitutes. The parameter θ_i reflects the importance of domestic intermediate goods in the production of good x_i. Note that the local content in x production in countries 1 and 2 is assumed to be identical, as is local content in countries 3 and 4. Throughout, the model will impose symmetry across West European countries and across East European countries, but will allow some asymmetries between East and West.

The second good, *v*, is produced in a vertical production chain that involves a production sharing arrangement between firms in the East and the West. The two production sharing sectors (one between 1 and 3, and the other between 2 and 4) combine local and foreign inputs according to:

$$v_{1t} = \left[\lambda^{1-\zeta} (v_{11t})^{\zeta} + (1-\lambda)^{1-\zeta} (v_{13t})^{\zeta} \right]^{\frac{1}{\zeta}}$$

$$v_{2t} = \left[\lambda^{1-\zeta} (v_{22t})^{\zeta} + (1-\lambda)^{1-\zeta} (v_{24t})^{\zeta} \right]^{\frac{1}{\zeta}}$$

The parameter λ measures the share of West European intermediate goods in the production of the good produced through production sharing. One interpretation of good *v* is that it is the product of a multinational enterprise (MNE) headquartered in Western Europe in conjunction with its foreign affiliate in East Europe. To capture the flavor of production sharing in a simplified way, I assume that inputs into the production of good *v* are complements relative to the production of the good *x*. So, the elasticity of substitution in the production sharing sector, 1/(1-ζ), is assumed to be small relative to 1/(1-ρ).

Each country produces a nontraded final good, *y*, that is used for consumption or investment. In West Europe (countries 1 and 2), the final good is a composite of goods *x* and *v*, combined according to:

$$y_{it} = (x_{it})^{\omega} (v_{it})^{1-\omega}.$$

By assumption, countries in East Europe do not engage in outsourcing to other countries, so in countries 3 and 4, $y_{it} = x_{it}$.

The resource constraints for each of the four countries are given by:

$$L_1 z_{1t} = L_1 x_{11t} + L_2 x_{21t} + L_3 x_{31t} + L_1 v_{11t}$$

$$L_2 z_{2t} = L_2 x_{22t} + L_1 x_{12t} + L_4 x_{42t} + L_2 v_{22t}$$

$$L_3 z_{3t} = L_3 x_{33t} + L_1 v_{13}$$

$$L_4 z_{4t} = L_4 x_{44t} + L_2 v_{24t}$$

Intermediate goods produced in West Europe (countries 1 and 2) are used as local inputs at home, in the other West European country in the non-production sharing sector, or in East Europe, either in the production-sharing or the non-production sharing. This implies that trade with the West involves goods that are substitutes (different varieties, for example), while trade with the East is a mixture of inputs that are substitutes, and inputs that are used in the production-sharing sector. Intermediate goods produced in the East (countries 3 and 4) are either used at home, or in the production-sharing sector. Therefore, all of East European exports are inputs in the vertical production chain.

The final good resource constraint in each country (*i=1,2....,4*) is given by:

$$y_{it} = c_{it} + i_{it}$$

where $i_{it} = k_{it+1} - (1-\delta)k_{it}$.

I assume that households can trade securities contingent on all states of nature. Under complete markets, the solution to a planner's problem yields allocations that are Pareto optimal and correspond to a competitive equilibrium. The planner maximizes:

$$\max L_1 U_1 + L_2 U_2 + L_3 U_3 + L_4 U_4$$

subject to the technology and resource constraints described above. By choosing a suitable set of initial wealth levels, the competitive equilibrium allocations are identical to the ones that are obtained by solving this planner's problem. Furthermore, prices can be computed from marginal rates of substitution across goods where the numeraire is the price of the good produced by country 1.

4. Parameter values and steady state solution

Table 6 shows the parameter values used in solving the model. The table also compares the steady state shares generated by the model with the corresponding figures from the data (averages across the four countries in each region). I follow Backus, Kehoe and Kydland (1995) and Burstein, Kurz and Tesar (2005) in choosing the values of β, σ , δ , and α. The period length is one quarter. The rate of time discount, β, is set equal to 0.99 so that the quarterly real interest is 1%. The coefficient of risk aversion, σ, is set equal to 2. Labor's share of output, α, is set equal to 0.4 and the rate of depreciation, δ, to 0.025. The parameter, λ, which reflects the share of local inputs in the production sharing sector is set equal to 0.5 (see the discussion in section 2).

The parameters $\{n_1, n_3, \theta_1, \theta_3, \omega\}$ jointly determine the steady state ratios in part B of Table 6: the ratios of country sizes (East Europe to West Europe), trade as a share of GDP in each region, imports from (other) West European countries as a share of total imports, exports to (other) West European countries as a share of GDP and exports of the production sharing sector as a share of total exports to CEEC. In measuring trade flows in the model, I assume that v_{11} is initially shipped to the East, v_{13} is added to produce good v_1 which is then shipped back to the West.[11] The ratio of East to West country size (measured as real GDP) in the data is 0.17.[12] The model produces a ratio of 0.18. Trade as a share of GDP is 0.81 in West Europe and 2.03 in East Europe. The steady state of the model replicates these ratios fairly closely at 0.87 and 1.98 respectively. Imports from other West European countries (see Table 2) accounts for 58 percent of total imports in the sample from West Europe – the model generates a value of 55 percent. In East Europe, imports from West Europe account for about 70 percent of total imports. Because the model only allows for East-West trade, the percentage of imports from the West as a share of total imports is 100 percent. The next line of Table 6 shows exports to West Europe as a share of GDP. In the two regions, the shares are 0.20 and 0.42 respectively. The model generates values of 0.26 and 1.21. The model clearly overstates the volume of exports from the CEECs to West Europe.[13]

[11] An alternative assumption is that v_{13} is shipped from the East for further processing and distribution in the West. Allocations are identical under the two assumptions with the exception of the gross volume of trade, which is larger under the first assumption.

[12] All figures reported in the calibration section are averages of the four West European and the four CEEC countries in my sample using the most recent year for which data are available (usually 2004). Thus, the calibration can be thought of as the effects of trade starting from the current situation.

[13] In calibrating the model, there is a trade off between capturing the overall importance of trade in GDP or in matching bilateral trade shares. I opted in favor of matching the trade to GDP ratio at the expense of overstating the share of CEEC flows to West Europe in total CEEC trade.

With the steady state in place, the next step is to set the shocks to productivity and the elasticities of substitution between domestic and foreign intermediate inputs in the production of good x and the production sharing good, *v*. I again follow BKK and set the persistence of the shocks to 0.91. To isolate the effect of trade on the correlation between output in the East and the West, I assume that shocks to productivity in countries 1 and 2 are uncorrelated with the shocks in 3 and 4, and further assume that the shocks between 3 and 4 are uncorrelated. I allow for correlated shocks among West European countries to match the observed within West European output correlations in the data (approximately 0.5). In the non-production-sharing sector, *v*, I assume the elasticity of substitution between inputs is 2 ($\rho = 0.5$). In the production sharing sector I assume inputs are strong complements ($\zeta = -20$).

The model is solved using standard log-linearization techniques. A matrix of productivity shocks is fed into the model, generating time series for each of the four countries. Moments are computed based on this artificially generated data. The procedure is repeated 1000 times. The figures reported in subsequent tables are the averages across simulations.

5. Results

Table 7 reports the results from a number of experiments exploring the impact of trade between the CEECs and West Europe on output correlations.[14] Four correlations are reported for each experiment: the within West European correlation, the within CEEC correlation, the correlation across the CEEC and West Europe and finally a pan-European correlation.[15] The results in the first row are based on the assumption that there is no trade between East and West (and hence no near-shoring of production). The positive correlation within West Europe of 0.49 is due to positively correlated shocks to productivity within West Europe.

The second row reports the results for a benchmark case in which there is trade between East and West, but all trade is of the standard form where inputs are assumed to be good substitutes. As East-West trade expands relative to the no-East-West-trade experiment in the first row, the output correlation within West Europe drops slightly. Substitutability of inputs results in a weak negative transmission of the cycle between the CEECs and West Europe with a correlation of –0.02. The third row repeats the experiment with nearshoring to East Europe (i.e. complementarity in the *v*-sector), holding all other parameters fixed. This shift leaves the output

[14] In reporting the results, I focus on the cross-country correlations. The model produces the usual set of business cycle moments for each country (smooth consumption relative to output, volatile investment relative to output, etc.). These moments are not reported here but are available upon request.

[15] This is an average of all bilateral correlations produced by the model {(1,2),(1,3),(1,4),(2,3),(2,4),(3,4)} where each pair receives equal weight.

correlations within each region largely unaffected. However, the correlation between East and West increases from -0.02 to 0.13 and the all-Europe correlation increases from 0.06 to 0.16. In this case, an increase in productivity in country 1 increases demand for inputs from country 3, driving up GDP in both countries.[16] Note that the assumption of no trade between countries 3 and 4 implies that there is no direct connection between the CEEC economies – therefore throughout the experiments (in the absence of correlated shocks in the CEECs) the correlation between CEECs is virtually zero and the model will therefore not generate the West-West, East-East, East-West ranking observed in the data.

To better understand how shocks are transmitted through trade, Figures 4a through 4c show the impulse responses of output, labor, relative prices and consumption to an increase in country 1 productivity. Each plot contrasts the allocations under substitutability and under complementarity. Turning first to Figure 4a, the increase in country 1 productivity results in an increase in the relative price of country 3's intermediate good relative to country 1's intermediate good under both scenarios. However, the price increase is roughly 30 percent larger under production sharing, reflecting country 1's relatively inelastic demand for v_{13}. The price increase induces households in country 3 to shift resources out of the x-sector (x_{33} falls) to the v-sector (so v_{13} can increase by more). Because households consume and invest good x, and investment remains high to meet the continued demand for inputs in country 1, consumption must fall. Figure 4b shows that, in addition to giving up consumption, households also reduce leisure. The increase in demand for v_{13} induces country 3 to intertemporally shift labor supply to increase output of the good in the production sharing sector. Figure 4c shows the response of output. Under substitutability, output of good three drops after the initial impact, while under production sharing it increases.

In previous work, Burstein, Kurz and Tesar (2005) examine a similar kind of model and find that the impact of production sharing on output correlations is minimal. The international transmission mechanisms are stronger here for two reasons. First, trade is a larger share of economic activity for the European countries (East and West) than it is in the context studied by BKT (extra-European trade, US and Mexico).[17] Second, the share of domestic value-added in the production sharing sector is larger in the East European countries than in Mexico's maquila sector. Because more domestic resources are involved in the sector, shocks are more readily transmitted through trade.

[17] The model does include East-West trade, but much of the calibration is pinned down by maquiladora data in Mexico.

The last two rows of Table 7 report the results of two additional experiments. The fourth case assumes that there is production sharing between East and West and that shocks within the East are weakly positively correlated (the innovations to productivity are assumed to have a correlation of 0.25). This experiment reveals that the nature of trade, not the underlying correlation of shocks, pins down the correlation between East and West. The only effect of correlated shocks in the CEECs is to increase the within CEEC correlation, and by definition, the all Europe correlation. The final experiment examines the effect of an increase in East-West trade.[18] Rose (2000) estimates that the eurozone could produce a 200 percent increase in trade flows within Europe. Here I consider a much more modest increase in East-West flow of 50 percent as a share of GDP.[19] Comparing these results to the benchmark of Case 3, the model produces an East-West correlation of 0.36 and an all-Europe correlation of 0.32.[20]

Taken together, the simulation results suggest that trade has a sizable impact on output correlations between East and West. The co-movement of output is sensitive to the nature of trade (i.e. whether inputs are substitutes or complements) and is less sensitive to the overall volume of trade or to the underlying shocks to productivity.[21] In general, the results suggest that production sharing between East and West works as strong linkage between the two regions. Whether this linkage makes coordinated monetary and fiscal policy easier or more difficult, however, depends on what feature of the economy policymakers are most concerned about. Table 8 reports co-movements between output as well as consumption, investment and labor for Cases 2 and 3 (intermediates as substitutes or as complements). The main differences between the two cases arise in the correlations between East and West, reported in the last column. Consumption is more strongly correlated in the case of substitutability between inputs. However, output and labor are more correlated in the case of production sharing. Interestingly, Darvas and Szapary (2004) find that while output correlations between the CEEC countries and core EU countries have increased over time, consumption correlations have not. While this should not be taken as definitive evidence, their finding is consistent with expanded trade and production sharing between East and West.

---

[18] In this experiment, θ_3 is set equal to 0.25. The ratio of trade in GDP in countries 3 and 4 increases from 1.98 in the benchmark case to 3.0.

[19] It is not possible to increase trade flows 200 percent in the model without adjusting country sizes. Under the 7:1 ratio assumed here, countries 3 and 4 are not large enough to meet the demands of countries 1 and 2 consistent with such large trade shares.

[20] The responsiveness of output correlations to increases in trade shares reported here are much larger than those found by Kose and Yi (2006). The primary difference between the two models is that within-Europe trade shares are much larger than the trade shares of the countries included in their study.

[21] One caveat that should be noted is that I have only explored productivity shocks. It is conceivable that demand shocks, either working through preferences or shifts in government spending, would have different effects on the transmission of cycles. Treatment of a broader set of shocks is left for future work.

6. Conclusion

This paper explores the implications of an increase in the volume of East-West trade on output correlations in Europe resulting from an expansion of the eurozone. The volume of near-shoring production by West European companies in East Europe is shown to play a critical role in the co-movement of output, labor and consumption in the two regions. If production sharing continues to dominate trade flows, output is likely to become more correlated as trade flows expand. On the other hand, if trade shifts toward a more "standard" type of flow, where intermediate goods produced in different countries are substitutes for each other, the transmission of the business cycle will likely be negative. Given the current magnitudes of trade flow and nearshoring in East Europe, the model generates an East-West output correlation of 0.13 and a correlation of 0.16 for Europe as a whole. These should be interpreted as lower-bound predictions stemming purely from trade flows. If increased integration between East and West Europe also entails technology transfer, more readily transmitted supply shocks or better coordinated economic policies, the resulting output correlations will likely be much larger.

References

Ambler, S., E. Cardia and C. Zimmerman, 2002, International transmission of the business cycle in a multi-sectoral model, European Economic Review 46, 273-300.

Artis, Marcellino and Proietti, 2003, Characterising the business cycle for accession countries, Working paper.

Backus, David K., Patrick J. Kehoe, and Finn Kydland, 1995 International Business Cycles: Theory vs. Evidence, in Thomas F. Cooley, ed., Frontiers of Business Cycle Research, Princeton University Press

Baxter, Marianne and Michael Kouparitsas, 2002, Trade structure, industrial structure and international business cycles, Federal Reserve Bank of Chicago Working paper 2002-30.

Bergin, P.R., G.H. Hanson, and R.C. Feenstra, 2005, Outsourcing and volatility, Working paper.

Boone, L. and M. Maurel, 1998, Economic Convergence of the CEECs with the EU" CEPR Discussion Paper Series No. 2018

Bordo, Michael D. and Thomas Helbling, 2004, Have national business cycles become more synchronized? Kiel Conference volume.

Canova, F. and H. Dellas, 1993, Trade interdependence and the international business cycle, Journal of International Economics 34 (1-2): 23-47.

Chen, H. and K. Yi, 2003, Vertical Specialization and Trends in US International Trade, mimeo.

Criscuolo, C., 2005, The contribution of foreign affiliates to productivity growth: Evidence from OECD countries, OECD STI Working paper series.

Darvas, Z. and G. Szapary, 2004, Business cycle synchronization in the enlarged EU, Working paper.

Ekholm, K., R. Forslid and J.R. Markusen, 2003, Export-Platform Foreign Direct Investment, NBER WP 9517.

Feenstra, R. 1998, Integration of Trade and Disintegration of Production in the Global Economy, Journal of Economic Perspectives (April).

Feenstra, R. and G. Hanson, 2005, "Ownership and Control in Outsourcing to China: Estimating the Property Rights Theory of the Firm," Quarterly Journal of Economics, 120(2): 729-762.

Fidrmuc, J., 2003, Optimal path into the EMU: Big bang or gradualism? ECARES Working paper.

Fidrmuc, J. and I. Korhonen, 2004, A meta-analysis of business cycle correlation between the euro area and CEECs: What do we know – and who cares? BOFIT Discussion papers, no. 20.

Hanson, G., R. Mataloni, and M. Slaughter, 2005, "Vertical Production Networks in Multinational Firms," forthcoming Review of Economics and Statistics.

Harding, D. and A. Pagan, 2005, Synchronization of cycles, forthcoming Journal of Econometrics.

Heathcote, J. and F. Perri, 2003, Why has the US business cycle become less correlated with the rest of the world?, AEA Papers and Proceedings.

Helg, R. and L. Tajoli, 2002, Patterns of international fragmentation of production and implications for the labor markets, Politecnico di Milano working paper.

Hummels, D., Ishii, and K. Yi (2001), The Nature and Growth of Vertical Specialization in World Trade", Journal of International Economics (June 2001), 75-96.

Imbs, J., 1999, Co-fluctuations, CEPR Discussion Paper 2267.

Imbs, J., 2004, Trade, finance, specialization and synchronization, Review of Economics and Statistics 86 (3).

Kalemli-Ozcan, S., B. Sorensen, O. Yosha, 2003, Economics integration, industrial specialization: regional and international evidence, American Economic Review 93 (June), 903-918.

Kose, M.A. and K. Yi, 2001, International trade and business cycles: Is vertical integration the missing link, American Economic Review 91 (May), 371-75.

Kose, M.A. and K. Yi, 2006, Can the standard international business cycle model explain the relation between trade and comovement, Journal of International Economics 86. 267-95.

Marin, D., 2005, A new international division of labor in Europe: Outsourcing and offshoring to Eastern Europe, University of Munich Working Paper.

Mundell, R., 1961, A Theory of Optimum Currency Areas, American Economic Review.

OECD, Intra-industry and intra-firm trade and the internationalization of production, OECD Economic Outlook 71, 2002.

OECD, 2001, Measuring globalisation: The role of multinationals in OECD economies, SourceOECD.

OECD, Ongoing changes in the business cycle, OECD Economic Outlook 71, 2002.

Pavlinek (2005), Transformation of the Central and East European passenger car industry: Selective peripheral integration through foreign direct investment," in Turner, Foreign direct investment and regional development in East Central Europe and the former Soviet Union, Ashgate Publishing Ltd, Aldershot England.

Rose, A.K., 2000, One money, One Market: The effect of common currencies on trade, Economic Policy 30 (April), 8-45.

Ruhl, K., 2004, Solving the International Elasticity Puzzle, mimeo, University of Texas at Austin.

Suppel, R, 2003, Comparing economic dynamics in the EU and CEE. accession countries. ECB working paper no. 267.

Topolansky, A., 1998, The assembly industry in Hungary: Favorable business climate creates new opportunities for US industries, Industry, Trade and Technology Review of the USITC, March, pp. 9-15.

Turnock, D., 2005, Foreign direct investment and regional development in East Central Europe and the former Soviet Union, Ashgate Publishing Ltd, Aldershot England.

Yeats, A. J., 1999, Just how big is global production sharing?, World Bank WP.

Yi, K., 2003, Can vertical specialization explain the growth of world trade?, Journal of Political Economy, 111 (1) , pp. 52-102.

TABLE 1: Correlations of real output and industrial production for selected countries

1a. GDP (hp filtered, seasonally adjusted): 1995.1-2005.3

	Austria	France	Germany	Italy	Czech	Hungary	Poland	Slovakia	EU aggregate
Austria	1.00	0.76	0.59	0.52	0.08	0.51	0.42	(0.39)	0.79
France		1.00	0.77	0.78	(0.09)	0.52	0.18	(0.63)	0.94
Germany			1.00	0.70	0.19	0.56	0.17	(0.45)	0.90
Italy				1.00	(0.07)	0.30	0.09	(0.50)	0.83
Czech					1.00	0.82	0.15	0.19	0.02
Hungary						1.00	0.25	0.30	0.52
Poland							1.00	0.21	0.24
Slovakia								1.00	(0.58)

Average correlations:	Within Weur:	0.69	excluding EU aggregate
	Within Eeur:	0.32	
	Between Weur/Eeur:	0.05	excluding EU aggregate
	Between EU/Eeur:	0.05	

(Hungary's time series: 2000.1-2005.3)

1b. Industrial production (hp filtered, seasonally adjusted): 1990.1-2005.4

	Austria	France	Germany	Italy	Czech	Hungary	Poland	Slovakia	EU aggregate
Austria	1.00	0.77	0.52	0.74	0.03	0.52	0.27	(0.03)	0.75
France		1.00	0.75	0.76	0.14	0.49	0.30	0.16	0.91
Germany			1.00	0.54	0.42	0.54	0.45	0.47	0.84
Italy				1.00	0.01	0.28	0.17	(0.06)	0.81
Czech					1.00	0.48	0.67	0.84	0.27
Hungary						1.00	0.64	0.53	0.54
Poland							1.00	0.58	0.39
Slovakia								1.00	0.25

Average correlations:	Within Weur:	0.68	excluding EU aggregate
	Within Eeur:	0.62	
	Between Weur/Eeur:	0.26	excluding EU aggregate
	Between EU/Eeur:	0.36	

1c. Industrial production: Manufacturing (hp filtered, seasonally adjusted): 1990.1-2005.4

	Austria	France	Germany	Italy	Czech	Hungary	Poland	Slovakia	EU aggregate
Austria	1.00	0.46	0.55	0.59	0.60	0.45	0.52	0.62	0.63
France		1.00	0.79	0.58	0.30	(0.01)	(0.05)	0.44	0.77
Germany			1.00	0.78	0.47	0.32	0.14	0.69	0.93
Italy				1.00	0.57	0.45	0.19	0.72	0.81
Czech					1.00	0.60	0.58	0.56	0.56
Hungary						1.00	0.48	0.51	0.37
Poland							1.00	0.26	0.29
Slovakia								1.00	0.73

Average correlations:	Within Weur:	0.62	excluding EU aggregate
	Within Eeur:	0.50	
	Between Weur/Eeur:	0.40	excluding EU aggregate
	Between EU/Eeur:	0.49	

(Czech's time series: 1991.1-2005.4)
(Hungary and Slovakia's time series: 1995.1-2005.4)
(Poland's time series: 1996.1-2005.4)

1d. Investment (hp filtered, seasonally adjusted, raw data in local currency): 1995.1-2005.3available

	Austria	France	Germany	Italy	Czech	Hungary	Poland	Slovakia	EU aggregate
Austria	1.00	0.81	0.85	0.32	(0.26)	0.03	0.59	(0.45)	0.82
France		1.00	0.78	0.51	(0.37)	0.14	0.30	(0.66)	0.88
Germany			1.00	0.36	(0.42)	0.11	0.53	(0.46)	0.91
Italy				1.00	(0.05)	0.11	0.02	(0.47)	0.51
Czech					1.00	(0.08)	(0.38)	0.35	(0.50)
Hungary						1.00	0.15	0.13	0.21
Poland							1.00	0.06	0.58
Slovakia								1.00	(0.46)

Average correlations:	Within Weur:	0.60	excluding EU aggregate
	Within Eeur:	0.04	
	Between Weur/Eeur:	(0.08)	excluding EU aggregate
	Between EU/Eeur:	(0.04)	

(Hungary's time series: 2000.1-2005.3)

Table 2: Bilateral trade shares (average shares 2000-04)

a. Imports by source as a share of total imports

	Imports from:				
	West Eur	East Eur	North Amer	Asia	other
Austria	0.66	0.10	0.05	0.10	0.09
France	0.59	0.03	0.08	0.16	0.14
Germany	0.49	0.07	0.08	0.18	0.17
Italy	0.55	0.04	0.05	0.15	0.20
Czech Rep	0.60	0.11	0.04	0.18	0.06
Hungary	0.58	0.07	0.04	0.25	0.06
Poland	0.61	0.06	0.04	0.20	0.09
Slovakia	0.49	0.21	0.02	0.22	0.05

b. Exports by destination as a share of total exports

	Exports to:				
	West Eur	East Eur	North Amer	Asia	other
Austria	0.60	0.10	0.06	0.08	0.16
France	0.62	0.03	0.09	0.11	0.15
Germany	0.54	0.07	0.11	0.13	0.15
Italy	0.53	0.04	0.11	0.13	0.20
Czech Rep	0.69	0.15	0.03	0.06	0.07
Hungary	0.74	0.06	0.04	0.06	0.10
Poland	0.69	0.07	0.03	0.09	0.12
Slovakia	0.60	0.26	0.03	0.04	0.07

Source: Source OECD, ITCS International trade by commodity.

Table 3: Trade and Manufacturing Shares of GDP

	1990	1995	2000	2004
A. (Exports + Imports)/GDP				
Austria	0.72	0.78	0.97	1.10
France	0.45	0.51	0.71	0.73
Germany	0.49	0.55	0.74	0.85
Italy	0.39	0.48	0.57	0.54
Czech Repub	0.83	1.26	1.85	2.46
Hungary	0.67	1.11	2.04	2.45
Poland	0.47	0.75	1.13	1.26
Slovakia	0.60	1.16	1.54	1.96
B. Exports + Imports of Mftd goods / Mftg value added				
Austria	2.92	2.98	3.67	4.11
France	2.22	2.39	3.15	3.32
Germany	1.77	1.89	2.68	2.92
Italy	1.39	1.90	2.34	2.38
Czech Rep		3.14	4.56	5.43
Hungary		3.20	6.16	5.65 (b)
Poland		1.98	2.81	3.81
Slovakia		4.85 (a)	5.78	7.12
C. Manufacturing value added/GDP				
Austria	0.19	0.18	0.20	0.20
France	0.16	0.16	0.17	0.16
Germany	0.25	0.23	0.22	0.22
Italy	0.22	0.23	0.22	0.21
Czech Repub	0.22	0.20	0.24	0.26
Hungary	0.22	0.22	0.25	0.26 (b)
Poland	0.31	0.33	0.38	0.42
Slovakia	0.24	0.22	0.20	0.21

Source: United Nations, GDP by expenditure and trade statistics
and OECD ITCS International Trade by Commodity Database
(a) Value for 1997.
(b) Value for 2003.

Table 4: FDI inflows into Eastern Europe

	Czech Republic	Hungary	Poland	Slovakia
a. Cumulated FDI inflow, 2000-2004 (in million $US	$25,681	$15,363	$36,406	$9,326
b. FDI inflow/GDP (average 2000-2004)	0.07	0.05	0.04	0.08
c. Share of inflow from: (average 2000-04)				
EU15	0.73	0.64	0.88	0.78
Austria	0.13	0.14	0.06	0.11
France	0.17	0.03	0.25	0.13
Germany	0.19	0.39	0.12	0.23
Italy	0.02	0.02	0.03	0.08

Source: Source OECD.

Table 5: Activity of foreign affiliates in Eastern Europe

	Czech Republic	Hungary	Poland	Slovakia
a. Value added of foreign affiliates as a share of total manufacturing value added (1)	0.26	0.70	n.a.	n.a.
b. Employment of foreign affiliates as a share of total employment, manufacturing sector (1)	0.27	0.47	0.19	n.a.
c. Turnover of foreign affiliates as a share of total turnover, manufacturing sector (1)	0.73	0.73	0.34	n.a.
d. Intermediate inputs shipped to affiliates as a share of total exports to Eastern Europe (2)				
Exports of Austrian parents	0.20	0.20	0.42	0.26
Exports of German parents	0.07	0.12	0.18	0.34
e. Intermediate and final good shipped from affiliates to parents as a share of total imports from Eastern Europe (3)				
Imports by Austrian parents	0.42	1.36 (4)	0.65	0.55
Imports by German parents	0.16	0.41	0.15	0.65

Sources:
(1) Figures for 1999. Data from Measuring Globalisation: The role of multinationals in OECD Ecoomies, SourceOECD.
(2) Marin (2005), Table 2, columns 1 and 3. Shares based on survey of 2200 investment projects in Eastern Europe undertaken by 660 firms, Statistik Austria.
(3) Marin (2005), Table 2, columns 2 and 4. Shares based on survey of 2200 investment projects in Eastern Europe undertaken by 660 firms, Statistik Austria.
(4) Figure is likely to be misleading as sales to Austria and sales to parent in Singapore could not be separated. See Marin (2005).

Table 6: Parameter values characterizing the model's steady state

a. Parameter values:

		West Europe	CEEC
L1, L3	size of labor force	2.9	1
σ	Coefficient of risk aversion	2	2
β	rate of time discount	0.99	0.99
δ	depreciation rate	0.025	0.025
$\theta 1, \theta 3$	share of home goods in non-production sharing sector	0.7	0.7
λ	share of WEur inputs in production sharing sector		0.5
ω	share of non-production-sharing goods in WEur GDP aggregator	0.8	

b. Steady-state ratios

	West Europe		CEEC	
	Data:	Model:	Data:	Model:
Ratio of country sizes (average GDP3/average GDP1)			0.17	0.18
Trade as a share of GDP	0.81	0.89	2.03	1.98
Imports from WEur as a share of total imports	0.58	0.55	0.69	1.00
Exports to WEur as a share of GDP	0.20	0.26	0.42	1.21

Table 7: Numerical results

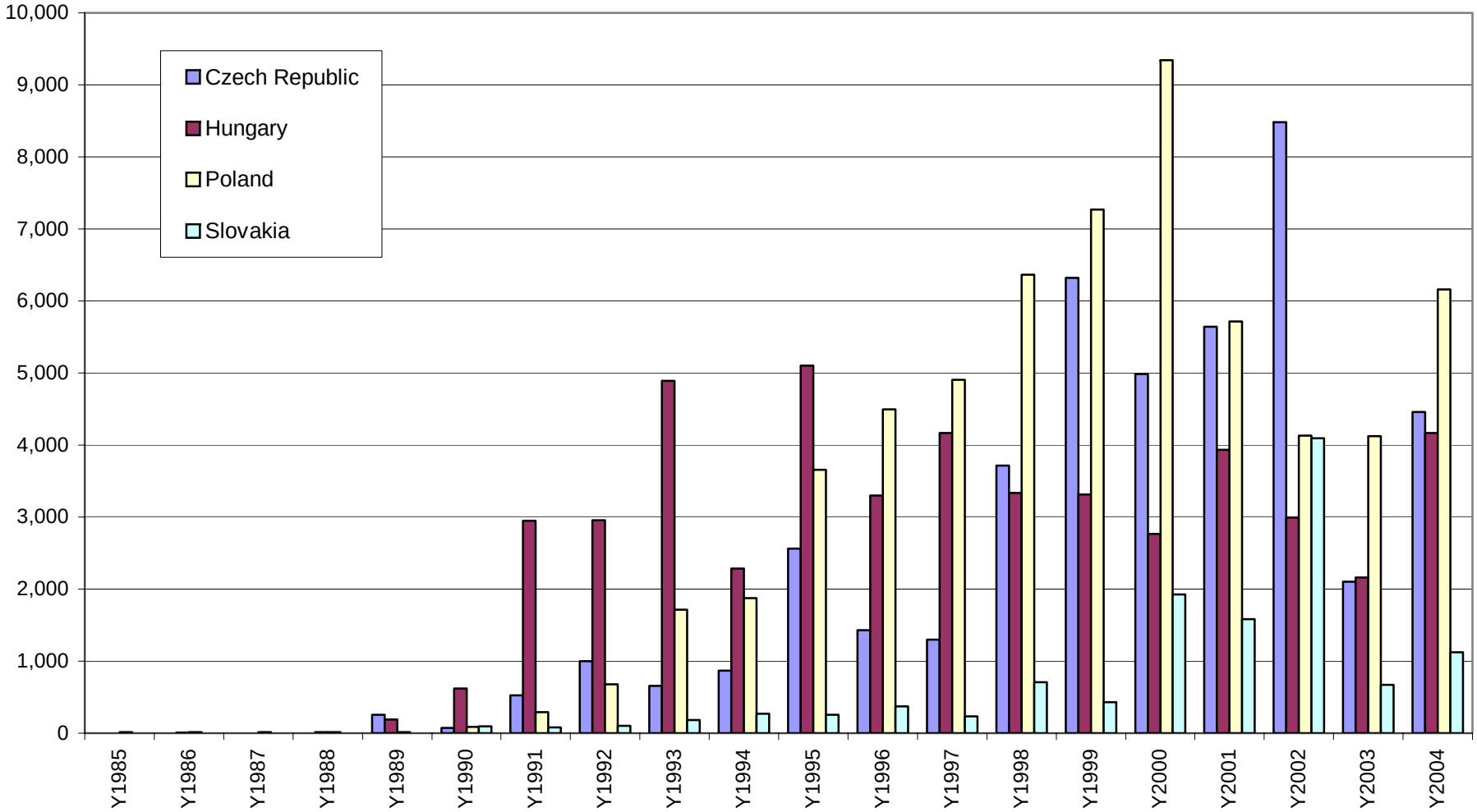
	Output correlations			
	within W. Europe	*within CEEC*	*between W Eur, CEEC*	*All Europe (*
Case 1: Trade within W Europe only, no trade with CEEC				
rho = 0.5 (elasticity of 2 in x sector)	0.49	0.00	0.00	0.08
corr(A1,A2) = 0.5, corr(A3,A4) = 0				
Case 2: Trade between all countries in intermediate goods, no production sharing				
rho = 0.5	0.46	-0.01	-0.02	0.06
csi = 0.5 (elasticity of 2 in v sector)				
corr(A1,A2) = 0.5, corr(A3,A4) = 0				
Case 3: Production sharing between W Eur and CEEC				
rho = 0.5	0.46	-0.01	0.13	0.16
csi = -20 (elasticity of 0.05 in v sector)				
corr(A1,A2) = 0.5, corr(A3,A4) = 0				
Case 4: Production sharing and positively correlated shocks in CEEC				
rho = 0.5	0.46	0.23	0.13	0.20
csi = -20				
corr(A1,A2) = 0.5, corr(A3,A4) = 0.25				
Case 5: 50% increase in W Eur-CEEC trade, with production sharing				
rho = 0.5	0.49	-0.01	0.36	0.32
csi = -20				
corr(A1,A2) = 0.5, corr(A3,A4) = 0				

(1) all Europe correlation calculated as the average of the six bilateral correlations in the model.

Table 8: Correlations between output, consumption and labor supply

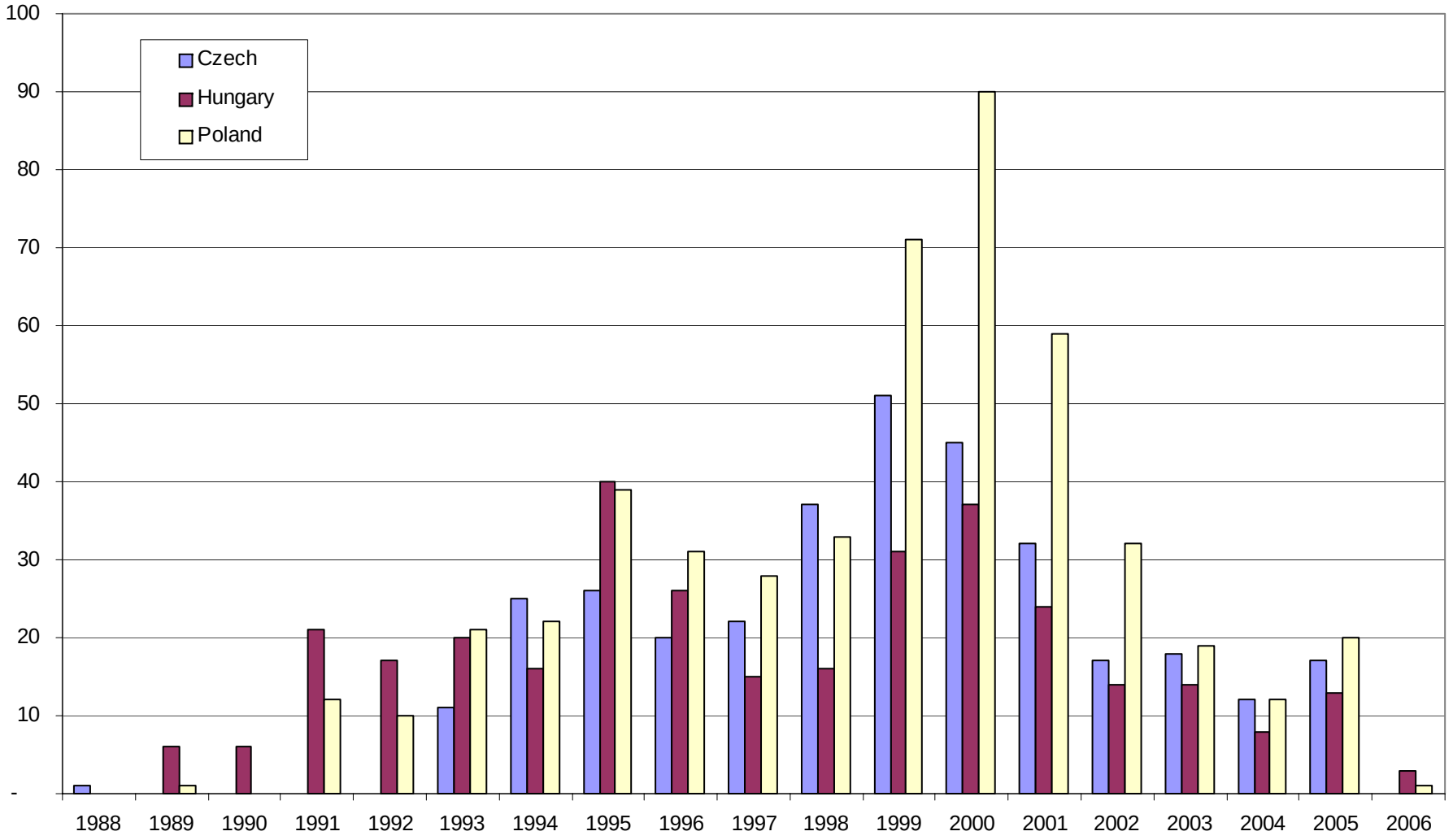
	Correlations		
	within W. Europe	*within CEEC*	*between W Eur, CEEC*
All inputs substitutes			
output	0.46	-0.02	0.06
consumption	0.76	0.04	0.23
investment	-0.07	-0.07	-0.55
labor	0.49	-0.02	0.06
Production sharing between W Eur and CEEC			
output	0.46	-0.02	0.16
consumption	0.79	0.01	0.02
investment	-0.02	-0.07	-0.43
labor	0.48	0.05	0.54

Figure 1: FDI inflows in East Europe
($US million)



Source: United Nations World Investment Report.

Figure 2: Number of foreign M&A transactions in East Europe, 1988-06



Source: SDC Thompsons.

Figure 3: Pattern of trade between West and East Europe

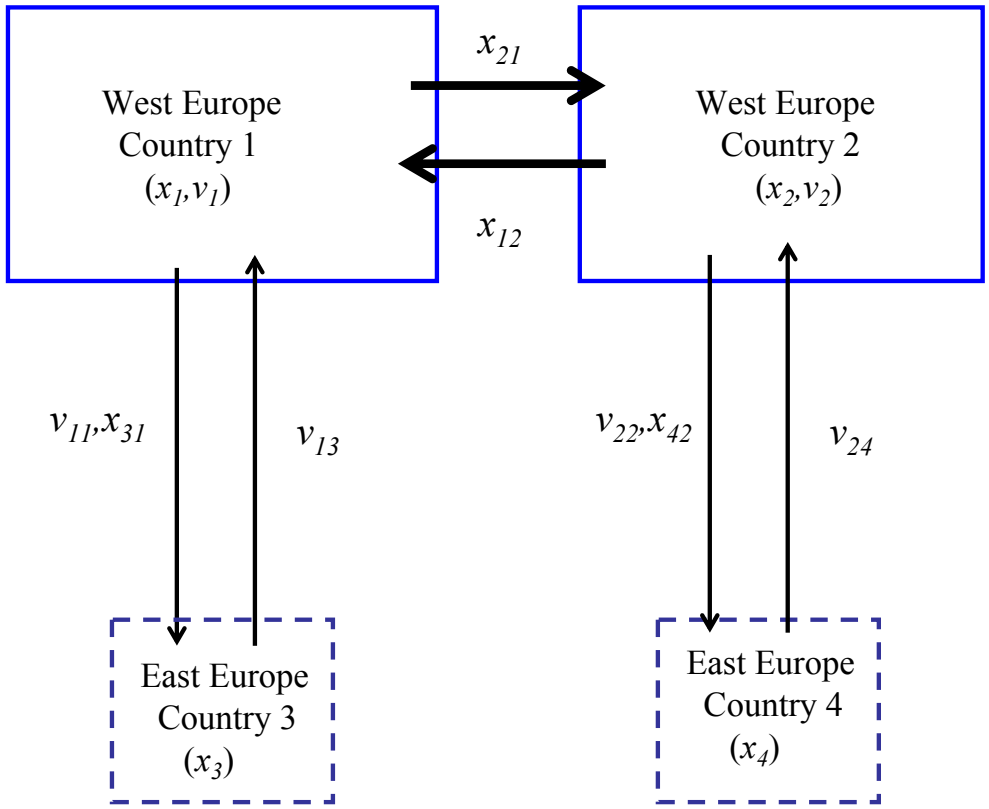


Figure 4a: Impulse responses of the relative price of good 3 and consumption in Country 3 in response to a Country 1 productivity shock

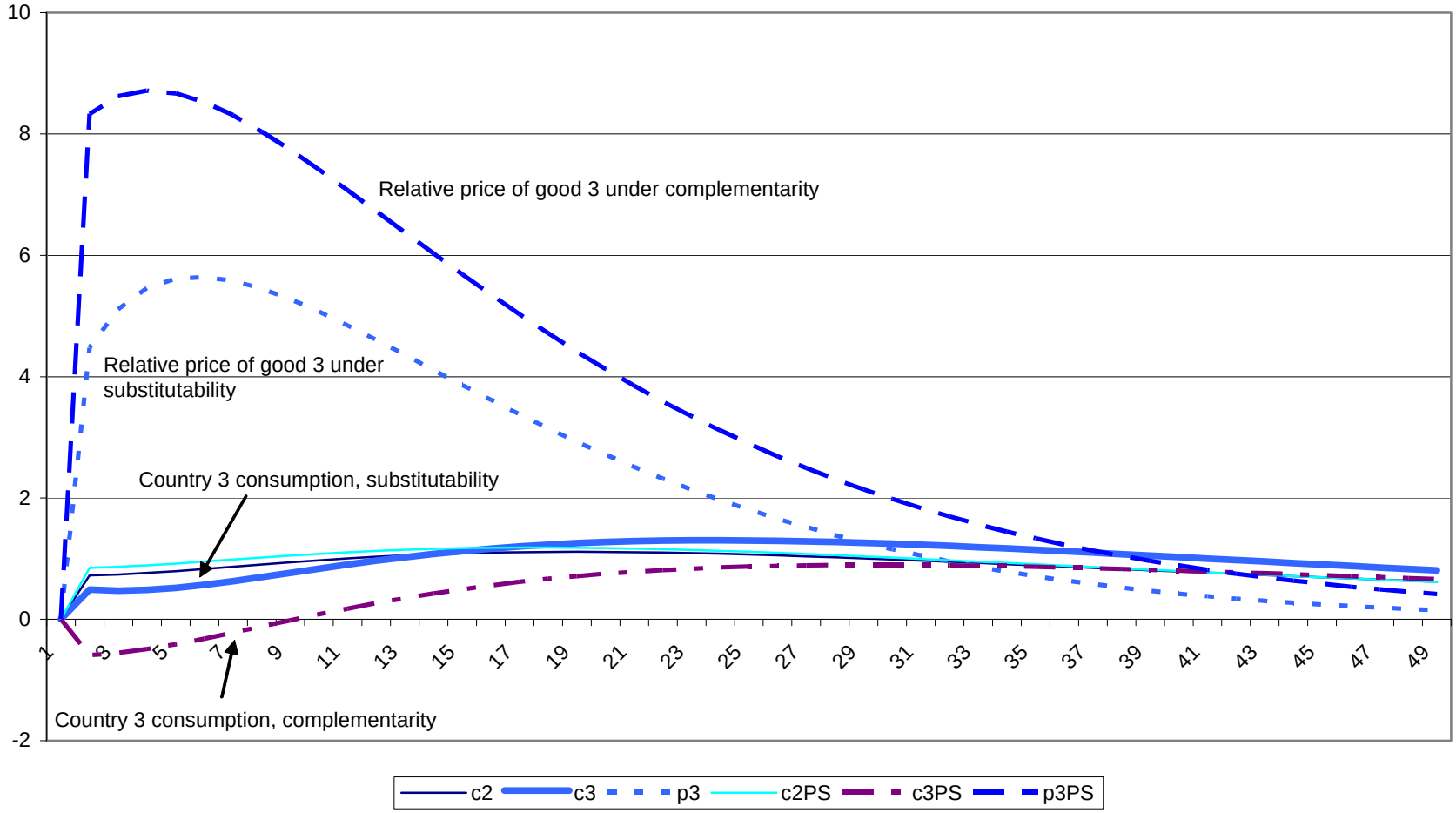


Figure 4b: Impulse responses of labor supply in Countries 2 and 3 in response to a Country 1 productivity shock

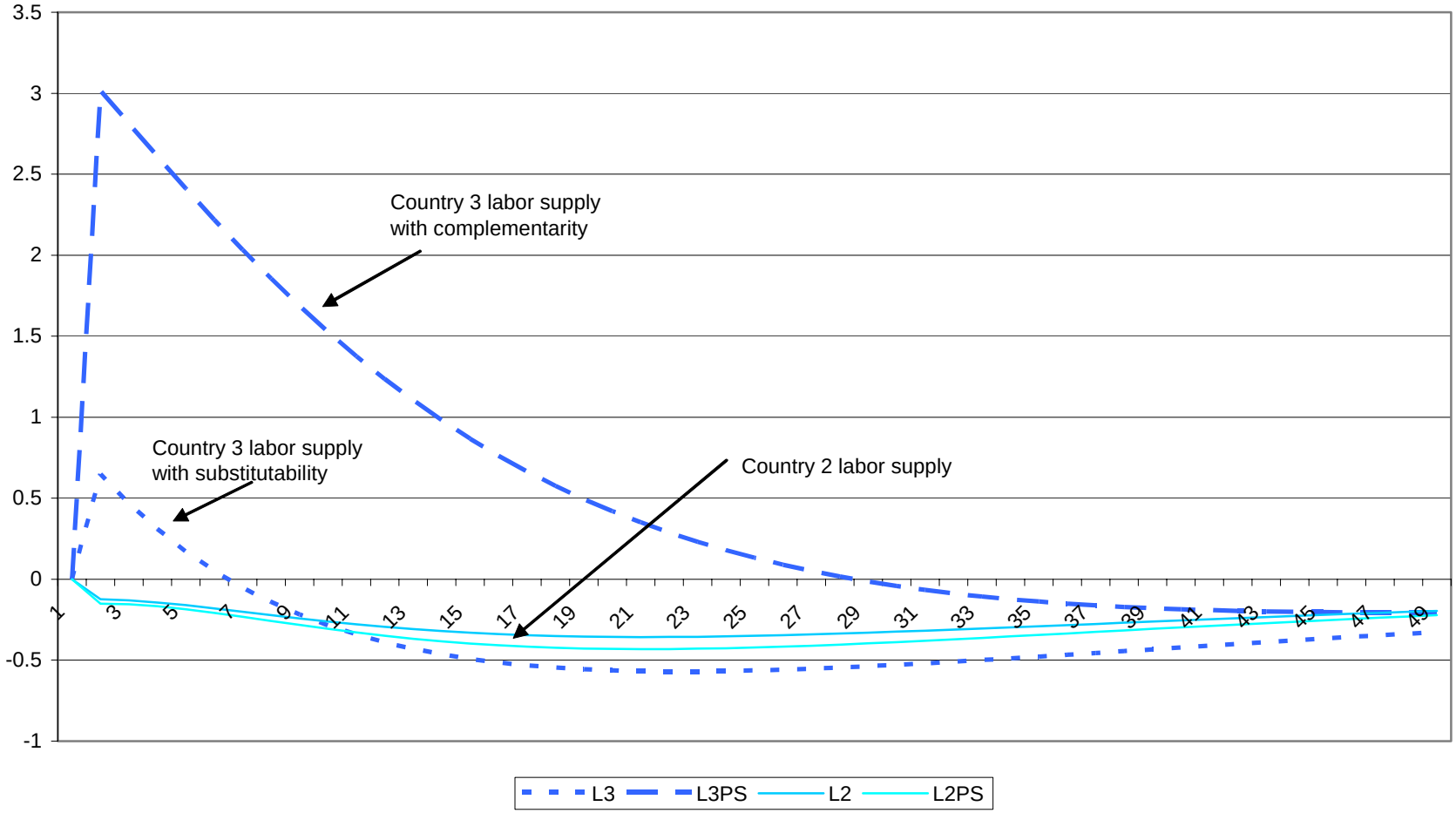


Figure 4c: Impulse responses of output in Countries 2 and 3 in response to a Country 1 productivity shock