# Understanding the Contributions of Reallocation to Productivity Growth: Lessons from a Comparative Firm-Level Analysis

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Abstract

We analyze comprehensive manufacturing firm data to measure the contribution of inter-firm employment reallocation to aggregate productivity growth during the socialist and reform periods in six transition economies. Modifying a standard decomposition technique to better reflect the role of firm entry, we find that reallocation rates and productivity contributions are very low under socialism, but they rise dramatically after reforms, and productivity contributions greatly exceed those observed in market economies. Early in transition, more reform is associated with larger contributions from reallocation, but later, and on average over the whole transition, this relationship is reversed. Though reallocation rates are larger in faster reforming economies, higher productivity dispersion in slower reformers creates higher productivity gains for a given volume of reallocation. The results imply that reallocation should be viewed as necessary regular maintenance for a well-functioning economy, and particularly large productivity contributions tend to reflect previous neglect more than current virtue.

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## 1. Introduction

Basic economics stresses the crucial role of resource allocation in achieving efficiency and implies as a corollary the importance of flexible reallocation in fostering economic growth. Until recently, however, data constraints have prevented empirical research from quantifying the magnitudes and contributions of reallocation. Comprehensive panel data on business units are required, for example, to measure the extent to which aggregate productivity growth is driven by productivity improvements within firms as opposed to resource reallocation from less to more productive firms. Research on these questions is still in its early stages, but some of it has already suggested substantial contributions of reallocation to aggregate productivity growth.[1]

This paper extends research on reallocation and productivity in several ways: data, methods, comparative analysis, and interpretation. We study a set of formerly socialist economies that have been engaged in the transition from central planning for more than a decade, countries that have not received a great deal of attention but that we argue provide particularly interesting cases for investigating reallocation. We assemble comparable annual panel data with long time series on the universe (or near-universe) of manufacturing firms in six of these economies—Georgia, Hungary, Lithuania, Romania, Russia, and Ukraine—and we apply the same data-cleaning and statistical procedures to each of them, in order to obtain genuinely comparable results. Following previous studies of productivity-enhancing reallocation, our measurement approach relies on decompositions of aggregate productivity growth (particularly those of Haltiwanger, 1997, and Foster, Haltiwanger, and Krizan, 2001); we propose a modified method that we argue better reflects the contribution from entry.

Why do some economies achieve more productivity growth via reallocation of resources from lower- to higher-valued uses? Many previous studies maintain, implicitly or explicitly, that higher contributions of reallocation to productivity growth result from better policy and business environments with lower costs of adjustment. While earlier research has usually focused on single economies in a narrow window of time, a logical next step is to use comparable microdata from different economic policy contexts to understand how these factors affect the pace and contributions of reallocation.[2]

Exploiting the cross-country and time series dimensions of our data, we carry out a comparative analysis of reallocation and productivity across an extraordinary variety of policy settings. By all accounts, the socialist economies had poor innovation incentives and selection mechanisms, suggesting much weaker processes of creative destruction under central planning than in well-functioning market economies. The collapse of Communist rule and subsequent liberalization (in the early to mid-1990s) opened up opportunities for rapid restructuring to

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[1] See, for instance, Baily, Hulten, and Campbell (1992) and Foster, Haltiwanger, and Krizan (2001) for the U.S.; Griliches and Regev (1995) for Israel; Liu and Tybout (1996) for Chile and Columbia; Aw, Chen, and Roberts (2001) for Taiwan; Disney, Haskel, and Heden (2003) for the UK; and Bartelsman, Haltiwanger, and Scarpetta (2004) and Brown and Earle (2002, 2006) for a few transition economies.

[2] Developing such data for multiple countries is even much more difficult than for a single economy. Moreover, variations in data (collection methods, coverage, frequency, and definitions), in cleaning procedures (particularly the construction of longitudinal links), and in decomposition methodologies can make comparisons difficult if not impossible. But our data are quite similar and we apply consistent methods of data preparation and analysis to the six countries. Bartelsman, Haltiwanger, and Scarpetta (2004) study the results produced by other researchers using a common program for several countries in the early to mid-1990s. Aw, Chung, and Roberts (2003) compare productivity and turnover patterns in Taiwan and Korea in the 1980s, but they do not measure the productivity growth attributable to reallocation. Pavcnik (2002) and Eslava, et al. (2004) are before- and-after studies of the effects of reforms in single countries (Chile and Colombia, respectively).

address the accumulated patterns of misallocation. The six economies we study adopted different speeds of policy reforms and therefore may exhibit different responses in this early transition period as well as in the later transition, when the economies stabilized and growth resumed (particularly after 2000). Our data enable comparisons of the pace and productivity contributions of reallocation across these varied settings, as well as with the findings for other economies that are available from previous research. To help account for the variation in the size of productivity contributions, we propose and implement a method to decompose the differences into three components: the dispersion of productivity, the pace of reallocation, and the correlation between reallocation and relative productivity across firms.

We find that the reallocation rates and contributions to aggregate productivity growth are quite different in our data from the results that have been reported for other countries. They are different during the central planning years in that both the pace and contributions of reallocation in the economies we study are much lower than elsewhere. They are different after economic liberalization in that the contributions of reallocation to productivity growth become much higher than elsewhere. The pace of reallocation also rises quickly after reforms, but only to the levels of developed market economies (except for Hungary in the early 1990s and Georgia in the early 2000s, when it is much higher); in general, therefore, transition economies achieve larger productivity gains for roughly the same reallocation rates. Despite this anomaly, the results demonstrate both the small role of reallocation under central planning and the very effective creative destruction unleashed by economic liberalization. In this sense, our analysis strongly supports the conclusions of previous research on the productivity contributions of reallocation.

However, the magnitudes of these contributions differ considerably across the six economies we study. In Hungary, generally considered the fastest reformer among the six in our sample (and among the fastest of all transition economies), the reallocation contribution rises earlier than elsewhere and it reaches levels much higher than comparable figures for Western economies, but then it peaks quickly and declines to close to zero. Lagging reformers realize significant reallocation contributions more slowly, but when the contributions emerge they become still much higher than in Hungary or the West, and they persist through recent data. Contrary to conventional wisdom, the rank order across countries in the size of contributions of reallocation to productivity growth in recent periods as well as over the whole transition is inversely correlated with reform speed.

Our decomposition of the cross-country and over-time differences sheds light on these patterns. Reallocation led to no productivity growth in the centrally planned economies not only because so little reallocation occurred, but also because of a very low correlation between reallocation and relative productivity at the firm level, particularly in Soviet Russia: the direction of resource reallocation had little relationship with relative productivities. The rise in productivity-enhancing reallocation during the transition is proportionately greater than the rise in the pace of reallocation because of simultaneous rises in the dispersion of productivity and the correlation between reallocation and relative productivity.

Comparing across countries, we show that the increase in productivity dispersion was larger in the slower reforming economies, a result we interpret as reflecting less cleansing of low productivity firms in the early transition period. Meanwhile, the faster reformers have had much better within-firm productivity growth, facilitated by the weeding out of worse performers, the encouragement of experimentation from new entrants, and the enhanced competitive pressure on surviving incumbents. The two main components of productivity growth—within-firm and reallocation—thus tend to be negatively correlated in a cross-section of countries.

Somewhat paradoxically, therefore, we find that reallocation matters most when it appears to matter least, in terms of direct productivity contributions. Fast reformers experience an initial boost of productivity growth due to reallocation just after liberalization, but within a few years the contribution is negligible. Slow reformers permit the productivity distribution to widen so much that reallocation contributions become large later on. These findings support a more nuanced view of the role of reallocation in which indirect effects of market pressures may be more important than the direct contributions of reallocation to productivity growth.

While these results may be surprising to some observers, we argue that they can be interpreted using standard models of industry dynamics. To take one example, costs of entry in these models have implications for firm turnover rates and the productivity cut-off level for exiting firms. Lower entry costs imply lower productivity levels of entrants relative to incumbents and higher productivity levels of exiting firms. Thus, if entry costs are negatively associated with the quality of the business and policy environment, then a better environment may produce smaller direct contributions of reallocation to aggregate productivity growth. The initial burst of high contributions in fast reforming economies reflects the accumulated misallocations of socialism, and the subsequent decline in contributions reflects an improved, not a worsened business environment. The later but still larger contributions in the slower reformers result from a widening of productivity gaps that reflect the accumulation of missed opportunities for reallocation, thus representing past neglect more than current virtue.

The rest of the paper proceeds with a brief discussion of relevant models of industry dynamics, central planning, and the different economic reform programs adopted in the six countries in Section 2. Section 3 discusses the data and methods for measuring productivity and decomposing productivity growth. Section 4 contains the results of our measurement of the magnitude of reallocation and its contribution to productivity growth. We also analyze the extent to which differences in the contribution of reallocation to productivity growth across time and countries are associated with the underlying factors of reallocation volume, productivity dispersion, and correlation between reallocation and productivity differentials. Section 5 contains a brief conclusion.

## 2. Conceptual Framework

Our approach to analyzing reallocation and productivity is motivated by standard theories of industry dynamics with heterogeneous firms (e.g., Jovanovic, 1982; Hopenhayn, 1992; Hopenhayn and Rogerson, 1993; Ericson and Pakes, 1995). The key elements in these theories are costs of adjustment (entry, exit, investment, and factor changes), as well as uncertainty about the future evolution of productivity. A basic result from the theories is that firm turnover and reallocation occur even in stationary equilibrium. Of course, the data we are examining can hardly be considered as drawn from equilibrium environments, but the theories are nonetheless useful for understanding the association between productivity differences and firm dynamics and therefore reallocation-enhancing productivity.

Combining the models into a single framework for simplicity, let us assume that profit-maximizing firms in a competitive industry have heterogeneous productivity given by $q = q(k, l; \varphi, \alpha)$, where $q$ is a homogeneous output, $k$ is capital services, $l$ is labor services, $\varphi$ is an idiosyncratic disturbance, and $\alpha$ is an adjustment cost for changes in factor utilization. In the Jovanovic (1982) model, $\varphi$ represents a signal of true productivity, about which firms gradually learn, while in Hopenhayn (1992), $\varphi$ is a firm-specific shock with the distribution function $F(\varphi_{t+1}|\varphi_t)$ strictly decreasing in $\varphi_t$, so that future productivity tends to be increasing in current productivity. Entering firms pay sunk cost $C_e$ and receive an initial productivity draw from $G(\varphi)$.

Incumbents may choose to exit, paying $C_x$, which includes transaction costs of shutdown (e.g., bankruptcy proceedings) and benefits in the form of savings on fixed operating costs and realizations of scrap values for capital and outside opportunities of other factors. With the addition of an investment possibility, as in Ericson and Pakes (1995), a firm may try to improve its productivity by incurring cost $C_I$ to obtain a new distribution of productivity outcomes F' that stochastically dominates F. Finally, changes in factors $\Delta k$ and $\Delta l$ incur an adjustment cost $\alpha(\Delta k, \Delta l)$, which reduces current period output (Hopenhayn and Rogerson, 1993).[3]

These assumptions yield predictions for relative productivity levels: both entrants and exiting firms should have lower average productivity than survivors. They also have implications for the pace of reallocation among continuing firms and through firm turnover (entry and exit), for the cutoff level of productivity for firms to continue operating, $\varphi^*$, and for the effects of changes in costs on reallocation and productivity differentials. Increases in $C_e$ and $C_x$ tend to reduce entry, exit, $\varphi^*$, and the mean $\varphi$ of surviving firms. An increase in $C_I$ reduces productivity growth and reallocation, as firms are less likely to undertake investments that raise in expected productivity and growth relative to noninvestors. An increase in $\alpha$ raises exit but reduces reallocation and productivity of survivors. Increases in the noisiness of productivity signals, expanding the variance of F, raise the value of staying in the market and reduce $\varphi^*$, exit, and the mean $\varphi$ of surviving firms.

While the theoretical models contain a number of unrealistic assumptions—profit maximization, perfect competition, and homogeneous output, in addition to stationary equilibrium—we can use their basic insights to inform our analysis of the contributions of reallocation to productivity growth. Because lower $C_e$ tends to reduce the relative productivity of entrants, it decreases the contribution of entry. Lower $C_x$ (higher fixed cost of operating) raises $\varphi^*$ and the relative productivity of exiting firms and therefore tends to decrease the contribution of exit. Lower $\alpha$ makes factor adjustments cheaper, implying that firms are likely to engage in more frequent but smaller changes that each result in a smaller productivity gain, thus a lower contribution to aggregate productivity growth. Lower $C_I$ extends downward the upper tail of the firm distribution that invest and grow, resulting in an average lower productivity in the growing segment and a lower contribution of between firm reallocation. Lower uncertainty reinforces each of these relationships as it makes firms less reluctant to incur the corresponding sunk costs (of entry, exit, investment, or factor changes), because the adjustment is less likely to be reversed and is therefore more likely to take place.

These insights can be usefully applied in the empirical settings we are studying. Concerning the socialist period, most business decisions were tightly regulated if not directly controlled.[4] Enterprises had strong incentives to meet output targets but little incentive to contain costs or innovate. There was no effective competition from other domestic producers or from imports. Worker mobility was restricted, the enterprise-level wage bill was tightly controlled, and layoffs were difficult and rare.[5] Effectively, all the adjustment costs would be extremely high, with $C_e$ and $C_x$ both close to infinite from the firm's point of view.

[3] The precise form of these adjustment costs (convex, linear, lumpy) is not the essential issue here, but see the discussion of cost structure in Hamermesh and Pfann (1996).

[4] See Kornai (1992) and Gregory and Stuart (1997) for comprehensive overviews of the socialist system and early reforms. The term "centrally planned" is a standard label, but it is a partial misnomer. Planning generally involved aggregates at the industry ("branch") level, and most economic decisions at the firm level were not dictated from above but by bargaining between the firm and its supervising branch ministry.

[5] For a discussion of labor allocation in the Soviet Union, see Granick (1987). Gregory and Collier (1988) discuss Soviet unemployment, which, like layoffs, appears to have been very low, but not zero.

Conceivably, omnipotent and omniscient planners might have tried to allocate resources to fulfill the plan's output and efficiency goals. But planning and implementation could also be influenced by political objectives, among them rapid industrialization and large, prestigious projects. Moreover, even the most efficiency-minded planners faced difficulties controlling all the enterprises in the economy. The greatest obstacle was posed by a lack of reliable information, which arose from inherent features of the system: fixed prices, ratchet effects, and other incentives that discouraged innovation and information revelation about productive capacities. Thus, while it seems unlikely that the planners would have been very successful in resource allocation and reallocation, how the system actually performed is an empirical question—a very interesting one that we can address with our data.

The question is still more interesting in light of the variation in partial reforms adopted in the late socialist period. In Romania, no liberalization occurred until the Ceaucescus were overthrown at the end of 1989. By contrast, Hungary experienced a partial, gradual relaxation of the planning regime for the previous two decades under the rubric of "goulash communism," and decentralization of many economic decisions to the enterprise level accelerated from the mid-1980s. Effectively, these reforms would have reduced costs of entry, exit, investment, and factor adjustment. The Soviet Union began *perestroika* reforms in late 1988, although these were much more tentative than the earlier ones in Hungary. Our data permit some analysis of the effects of these differences, particularly involving Hungary and Soviet Russia, on the pace of reallocation and its consequences for productivity growth.

The adoption of wide-ranging reforms during the transition period (from about 1990) led to reductions in all types of adjustment costs, and the factors affecting reallocation and productivity begin to resemble those in market economies. Liberalization of prices, entry, exit, imports, and employment together with privatization may increase incentives for productive reallocation through improved corporate governance and competition. Nevertheless, the size of adjustment costs is a function of factors such as the macroeconomic and business environment, and observers have frequently suggested that, despite rapid liberalization, continued government intervention during the transition may stifle reallocation. Direct subsidization and other forms of support for weak and failing enterprises (soft budget constraints) may reduce fixed operating costs and impede exit, while discriminatory taxes, bureaucratic interference, poor contract enforcement, and uncertain property rights protection may raise entry and investment costs, thus hindering entrepreneurship and growth of more successful firms (e.g., Frye and Shleifer, 1997; Åslund, Boone, and Johnson, 1996). The transition economies could be subject to "sclerosis" (Caballero and Hammour, 1996), in which less productive matches fail to dissolve due to market imperfections and government policies, while the creation of more productive matches of resources and enterprises is impeded.

The six countries we study in this paper cover the spectrum of transition policy strategies, at least as conventionally measured in evaluations of "progress" in reform and transition by international organizations such as the European Bank for Reconstruction and Development (EBRD) and the World Bank. The World Bank's (1996) four-group classification of 26 transition economies, for example, puts Hungary in the first group of leading reformers, Lithuania and Romania in the second group, Georgia and Russia in the third, and Ukraine in the fourth. Similarly, the EBRD's annual indicators of "progress in transition" invariably place Hungary at or close to the top of all transition economies; its average score across the price liberalization, foreign exchange and trade liberalization, small-scale privatization, large-scale privatization, enterprise reform, competition policy, banking sector reform, and non-banking sector financial institutions indicators has been the highest or close to it among all transition economies since 1994. The other countries started their major reforms later, implemented them more gradually, and have still not bridged the gap with Hungary. Georgia and Ukraine started most slowly, but they rapidly converged with Romania and Russia in the late 1990s.[6]

Regardless of the exact figures, which are certainly subject to measurement errors and disputes, the clear policy differences in the six countries suggest an interesting set of comparative hypotheses. During the socialist period, Hungary's partial reforms may have stimulated a somewhat faster paced and more effective productivity-enhancing reallocation compared to Soviet Russia. During the transition, if more effective reforms stimulate productivity-enhancing reallocation, then Hungary's ambitious policy should be reflected in the fastest increase in the contribution of reallocation to productivity growth.[7] Although productive reallocation may be slowest to emerge in Georgia, Russia, and Ukraine, it should converge with that in Romania and Lithuania by the early 2000s. On the other hand, an alternative possibility suggested by the models of industry dynamics is that a reduction in adjustment costs may lead, at least over some range, to reduced contributions of reallocation to productivity growth. Lower costs of entry, for instance, will tend to lower the average productivity of entrants and raise the average of exiting firms relative to survivors, reducing the contributions to firm turnover. And lower costs of factor adjustment may lead to quicker responses that prevent large productivity gaps from developing. More generally, low adjustment costs may lead to low productivity dispersion, leaving little scope for reallocation to contribute to productivity growth. On the other hand, following liberalization, there may be an initial burst of productivity-enhancing reallocation, followed by a later period with relatively small direct contributions. Our empirical analysis provides evidence on these hypotheses.

## 3. Data and Basic Methods

### 3.1 Sources, Samples, and Variables

The paper uses annual census-type data for manufacturing firms in each of the six countries. Though the data sources and variables are similar, we have taken steps to make them sufficiently comparable to justify cross-country comparisons.

The basic sources for the Hungarian and Romanian data are balance sheets and income statements associated with tax reporting: to the National Tax Authority in Hungary and the Ministry of Finance in Romania. All legal entities engaged in double-sided bookkeeping report, with the exception of Hungary before 1992—when only a sample consisting of all firms with at least 20 employees and some smaller firms is available. The Romanian data are supplemented by the National Institute for Statistics' enterprise registry and the State Ownership Fund's portfolio and transactions data. The Hungarian data are annual from 1986 to 2005, and the Romanian data from 1992 to 2006. The sum of employment across all firms in the database is similar to the statistical yearbook number in both countries.

The other four countries are former Soviet Republics. Their data come from their national statistical offices, the descendants of the former State Statistical Committee

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[6] Success in macroeconomic stabilization followed a similar pattern, with Hungary experiencing the smallest cumulative output decline before recovering (15 percent), followed by Romania (21 percent), Russia (40 percent), Lithuania (44 percent), Ukraine (59 percent), and Georgia (78 percent). Hungary never experienced annual inflation over 35 percent, while the other countries' inflation rates exceeded 100 percent in some years, and Georgia, Russia, and Ukraine's rates did not fall below that level until 1996 (World Bank, 2002).

[7] Bartelsman, Haltiwanger, and Scarpetta (2004) suggest that the reallocation contribution to productivity growth is larger in transition countries implementing more institutional reform.

(*Goskomstat*), and therefore tend to be quite similar to one another. The Georgian and Lithuanian data cover most firms outside the budgetary and financial sectors in 1995-2005 (Lithuania) or 2000-2004 (Georgia). The Georgian and Lithuanian databases include roughly three-fourths of total manufacturing employment reported in the yearbooks. We also use data from the 1989 Soviet industrial registry to get a measure of pre-transition productivity dispersion in the two republics. Unfortunately, we are unable to link these data with the later years, since our more recent data do not contain firm names or locations.

The main sources in Russia and Ukraine are industrial enterprise registries from their national statistical offices, supplemented by balance sheet data.[8] The data span 1985-2004 for Russia, and 1989 and 1992-2006 for Ukraine. The Russian registries are supposed to include all industrial firms with over 100 employees as well as those that are more than 25 percent owned by the state and/or legal entities that are themselves included in the registry. In practice, it appears that once firms enter the registries, they continue to report even if these conditions no longer hold. The Russian data can therefore be taken as corresponding primarily to the "old" firm sector (and their successors) inherited from the Soviet period. The 1992-1996 Ukrainian registries contain all industrial firms producing at least one unit of output, where a unit is defined differently depending on the product. All legal entities outside the budgetary and financial sectors are included in the 1997-2006 registries. The pre-1992 Russian and 1989 Ukrainian data do not include firms in the military-industrial complex. The Ukrainian coverage is fairly complete except in 1989 (69 percent of employment). The Russian data cover nearly all activity through 1994; then the coverage declines to about 75 percent in more recent years as the de novo sector has grown.

Some truncation was necessary to make the samples comparable across countries. The data in all countries are limited to manufacturing (NACE 15-36). We exclude the tobacco industry (NACE 16) due to insufficient observations in four of the six countries and the recycling industry (NACE 37) because of noncomparability with the classification system used until recently in Russia and Ukraine. We also remove observations on variables showing highly volatile fluctuations according to any of the following criteria: increase/decline by a factor greater than 5 in one year then decline/increase by a factor greater than 5 in the next year, change by a factor greater than 10 in the year after entry, or change by a factor of 10 in the final year of observation.[9]

Following the previous literature on productivity growth decompositions, we analyze reallocation and productivity within industries, avoiding problems of comparisons across industries with very different technologies. Ideally one would prefer to use industries disaggregated to the level of product markets, so as to compare firms only to their competitors. On the other hand, since the productivity decompositions rely on deviations from the industry average, it is important to have sufficient numbers of firms in each sector to ensure reliable estimates. We have compromised by dividing manufacturing into 19 sectors, which are 2-digit NACE industries (except that 23 and 24 are combined, as are 30 and 32).

[8] The units of observation in these data are firms, except for multi-plant entities where individual plants are listed as "subsidiaries" (*dochernye predpriyatiya* or "daughter companies") in the Russian registries. Apparently most but not all cases of multiple plants are treated individually in Russia: the 1993 registry contains a variable indicating the number of plants, which equals 1 in 99.91 percent of the 18,121 nonmissing cases. To avoid double-counting, we have dropped the consolidated records of entities with subsidiaries from the analysis.

[9] Outliers defined on the basis of labor and output are excluded from labor productivity calculations and those defined on the basis of capital as well are excluded from multifactor productivity exercises. Excluded observations constitute about 1 percent of the labor productivity sample and about 2 percent of the MFP sample.

These data have been extensively cleaned to remove inconsistencies and to improve missing longitudinal linkages due to change of firm identifier from one year to the next (associated with reorganizations and changes of legal form, for instance). The inconsistencies were evaluated using information from multiple sources (including not only separate data providers, but also previous year information available in Romanian balance sheets and Russian and Ukrainian registries). The longitudinal linkages were improved using all available information, including industry, region, size, multiple sources for the same financial variables, and some exact linking variables (e.g., firm names and addresses in all countries except Georgia, Hungary, and Lithuania, where this information was not available) to match firms that exited the data in a given year with those that entered in the following year. For Hungary we also used a database with direct information on longitudinal linkages: if a firm changed its identification number for some reason (and it appeared in the data as a new entry or an exit), the database indicated whether it had a predecessor or successor and, if so, that firm's identification number.

To eliminate spurious exit and entry, we eliminated employment changes associated with disappearances followed by reappearances, as well as firm-years with more than 1,000 employees in the year of entry or exit. In Russia and Ukraine we also excluded firms in regions that are completely missing in the data in one of the two adjacent years, and those in industries with implausibly high entry or exit rates in that year (suggesting a change in sample coverage).[10] Entry and exit associated with firms that were members of Soviet-era production associations or that belong to multi-establishment firms were also excluded in Russia.[11]

Summary statistics and definitions for employment, output, and capital stock are reported for the first and last years in each country's data in Table 1. Average employment significantly declines everywhere except Georgia.[12] The particularly sharp declines in Hungary, Romania, and Ukraine can be explained by high rates of small firm entry after liberalization.[13]

### 3.2 Productivity Measures and Decompositions

We compute two types of firm-level productivity measures: labor productivity (LP) is calculated as the log of gross output or sales divided by number of employees, and multifactor productivity (MFP) is the residual from an industry-specific Cobb-Douglas production function of gross output (or sales) in capital and labor (using 19 manufacturing sectors). Both of these measures have been used in previous studies of reallocation-enhancing productivity. Because they do not distinguish firm-level quantity and price variation, which are unavailable in the data, they also conflate technical efficiency and firm-specific price variation, thus representing revenue productivity.[14] For our purposes, this is not necessarily a disadvantage, particularly if

[10] The size-related exclusions amount to no more than 0.3 percent of the sample in any country. The changes in industry and regional coverage result in the exclusion of about 2 percent of observations in Russia and Ukraine.

[11] The reason for excluding production association entry and exit during the Soviet period and multi-establishment firm entry and exit during the transition period is that many of these firms report inconsistently in the data. In one year a consolidated entity may appear, in the next each of the establishments may report separately, or vice versa. These exclusion rules result in a conservative bias. Of course some production associations may be starting new establishments or closing others down, and there may be some true entry and exit in industries with implausibly high rates and in regions that enter and exit the dataset.

[12] The Georgian data start only in 2000, and therefore do not exhibit a sharp decline. Georgia's average manufacturing employment in 1989 is 302.

[13] Average employment and output decline among old firms (enterprises inherited from the socialist system) samples as well, but the Hungarian, Romanian, and Ukrainian declines are much smaller than in the full samples.

[14] See Eslava et al. (2004) and Foster, Haltiwanger, and Syverson (2008) for analyses of firm-specific revenue and physical productivity.

variation in firm-specific prices reflects quality differences. Moreover, if revenue productivity has lower dispersion than physical productivity (as found by Foster, Haltiwanger, and Syverson, 2008, for some U.S. industries), then our calculations of the productivity consequences of reallocation would be still larger if measured for physical productivity.

In each case, the productivity values are aggregated into a constructed productivity index for each year and industry, and then the aggregates are decomposed using methods that have become standard in the literature. We then further decompose the effect of reallocation on productivity growth into productivity dispersion, reallocation volume, and the correlation between reallocation and productivity differentials (described in detail in Section 4.3). It bears emphasis that the decomposition approach allows an examination only of direct contributions of reallocation to productivity growth, ignoring any indirect effects, for example entrants as a source of market pressures on incumbents.

The method of decomposing aggregate productivity growth employed here is a modified version of the proposal of Haltiwanger (1997) and Foster, Haltiwanger, and Krizan (2001), hereafter referred to as FHK. Construction of aggregate labor productivity measures involves summing firm-level measures to the aggregate level:

$$P_t = \sum_i S_{it} \sum_e S_{eit} P_{eit} \tag{1}$$

where $P_t$ is aggregate productivity in year $t$, $S_{it}$ is the employment share of industry/sector $i$ in year $t$, $S_{eit}$ is the employment share of firm $e$ in industry $i$ and year $t$, and $P_{eit}$ is the productivity of enterprise $e$ in sector $i$ in year $t$.

FHK's "method I" decomposition expresses the change in aggregate sectoral productivity over a period of length $k$ (thus from year $t$-$k$ to year $t$), $\Delta P_{it}$ (where $P_{it} = \sum_e S_{eit} P_{eit}$ ), as follows:

$$\Delta P_{it} = \sum_{e \in C} s_{et-k} \Delta p_{et} + \sum_{e \in C} \left(p_{et-k} - P_{it-k}\right) \Delta s_{et} + \sum_{e \in C} \Delta p_{et} \Delta s_{et} + \sum_{e \in N} s_{et}\left(p_{et} - P_{it-k}\right) - \sum_{e \in X} s_{et-k}\left(p_{et-k} - P_{it-k}\right). \tag{2}$$

The first term in (2) measures the average change in firm productivity holding composition constant at its base year ($t$-$k$) structure, in order to distinguish average productivity growth from composition effects. This term may reflect firm restructuring and deterioration as well as mismeasured price and quality changes. The second term measures the between-firm (within-sector) reallocation effect, the covariance of share changes with the base year deviation of enterprise productivity from the industry mean. The third term measures the intrasectoral covariance of productivity and compositional changes, the "cross" effect, while the fourth and fifth represent the contributions of entry (N) and exit (X), respectively.[15] The fourth and fifth

[15] We have also examined an FHK method using average period weights, which has the advantage of being more robust to measurement error but provides a less intuitive way to measure reallocation contributions; in any case, the results from that analysis produce similar qualitative conclusions. But we do not use the Olley and Pakes (1996) cross-sectional decomposition (OP) of aggregate productivity into unweighted average productivity and covariance of deviations of employment shares and productivity from sector means. The OP approach may attribute some activities to within effects that the FHK decompositions treat as reallocation effects and vice versa. If two firms with fixed shares switch positions in the productivity distribution, OP reports a reallocation effect and FHK a within-firm effect from the change. When a firm above average in both size and productivity splits into two firms with the same productivity as the parent but below average size, this appears as a positive within effect and a negative reallocation effect with OP, but it has no effect on either the within effect or the reallocation effect in the FHK decompositions (the exit and entry terms cancel). OP treats exit of a firm below average in size and productivity as a positive within-firm and negative reallocation effect, while FHK treats the exit as a positive reallocation effect. In our view, the FHK accords more closely with intuition about reallocation.

terms combined are the net entry effect. We calculate the total reallocation contribution as the sum of the between and net entry effects.[16]

Notice, however, that the FHK net entry effect is not purely a reallocation effect. For instance, if exiting firms are just as productive on average as stayers in the initial period, and entrants are also equally productive as surviving incumbents in the final period, then the FHK net entry effect will simply be the entry share of activity multiplied by the change in sectoral productivity, i.e., its productivity growth contribution will be proportionate to its share of activity. Merely by mimicking incumbents, entrants may be credited with contributions to productivity growth, which is not a natural way to reckon such contributions. In a period of more rapid growth, this proportionate component will be larger, in a period of decline it will be negative, and in absolute value it will be larger the longer is *k*. Thus, even if entrants are identical to incumbents, the calculated contribution of entry will fluctuate with incumbent growth rates, and the extent of this covariation will vary with the period length under analysis.

An alternative approach is to compare entrants with incumbent productivity in year *t* and measure the contribution of net entry relative to a benchmark in which exitors are like incumbents in the exit year and entrants are like incumbents in the entry year. This can be accomplished by decomposing FHK's entry term as follows:

$$\sum_{e\in N} s_{et}\left(p_{et}-P_{it-k}\right)=\sum_{e\in N} s_{et}\left(P_{it}-P_{it-k}\right)+\sum_{e\in N} s_{et}\left(p_{et}-P_{it}\right). \tag{3}$$

The first term is the change in average sector productivity over the period, weighted by entrants' share, which may be labeled the "proportionate entry" term. The second term is the weighted average of entrants' productivity compared to the sector average in year *t*, the "disproportionate entry" term.[17] The entire decomposition becomes:

$$\Delta P_{it}=\sum_{e\in C} s_{et-k}\Delta p_{et}+\sum_{e\in C}\left(p_{et-k}-P_{it-k}\right)\Delta s_{et}+\sum_{e\in C}\Delta p_{et}\Delta s_{et}+\sum_{e\in N} s_{et}\left(P_{it}-P_{it-k}\right)+\sum_{e\in N} s_{et}\left(p_{et}-P_{it}\right)$$
$$-\sum_{e\in X} s_{et-1}\left(p_{et-k}-P_{it-k}\right). \tag{4}$$

The combination of exit and disproportionate entry show whether firm turnover contributes disproportionately to aggregate productivity growth. For comparison purposes, the FHK entry term can be recovered by simply adding the two entry terms in (4) together.

Besides providing a more natural measure of the entry contribution, the equation (4) decomposition also has the advantage of shifting any measurement error in firm turnover into the proportionate entry term. If longitudinal links in the data are randomly broken so that some average-productivity continuers are counted as exits and subsequent entrants, for example, their relative productivity would contribute to the FHK entry term. In our modified decomposition, random breaks of firm linkages are incorporated into the proportionate entry term, but do not affect the exit and disproportionate entry terms. Moreover, since productivity of entering firms is compared with incumbents' productivity in the same year, the disproportionate entry term is not sensitive to mismeasured price deflators.[18]

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[16] The cross term could partly be thought of as a reallocation contribution as well, though it is ambiguous how much of it is reallocation versus a within-firm effect.
[17] We thank John Haltiwanger for suggesting this terminology.
[18] Although they do not calculate the contribution of disproportionate entry as we do, Foster, Haltiwanger, and Krizan (2001) and Disney, Haskel, and Heden (2003) implicitly adopt the same perspective when they run regressions comparing the productivity of entrants in the final year to the productivity levels of exitors in the initial year and continuers in the initial and final years.

## 4. Results

### 4.1 The Pace of Reallocation under Socialism and in Transition

Before presenting the reallocation contribution decomposition results, we first report calculations of annual job reallocation measures following standard definitions (Davis and Haltiwanger, 1992; see also Dunne, Roberts, and Samuelson, 1989). Figure 1 shows job creation, job destruction, job reallocation, and intra-industry excess job reallocation, and Appendix Table 1 contains the underlying data for these series plus the shares of entry and exit firm employment in total employment. Job creation and destruction among continuing firms can be calculated by subtracting these shares from total job creation and destruction, respectively. The net change is negative in the early transition years in all countries, reflecting the sharp decline in the manufacturing sector during that period.

The pace of gross job flows under central planning, evidenced by the results from Hungary and Russia, are well below those typically found in market economies (which are typically 8-10 percent each for annual creation and destruction). However, the job flow rates during this period are significantly larger in Hungary than Russia because of both higher creation and destruction among continuing firms and more firm turnover. Even though Hungary experiences only a modest amount of firm turnover prior to the transition, the Russian data show virtually none. These patterns may reflect greater pre-transition reform in Hungary. Once the transition starts, there is a marked increase in job flows both from continuing firms and firm turnover. The increase is much larger in Hungary, which implemented faster reform.

Georgia experiences the largest creation and destruction rates on average during the transition.[19] The rates in Hungary, Lithuania, and Romania are also quite high. Russia and Ukraine experience significantly less reallocation both from continuers and firm turnover. The high job destruction rates in Lithuania, Romania, Russia, and Ukraine are primarily a result of high continuing firm contraction, while exit also makes a large contribution in Georgia and Hungary. In contrast to the high levels of job destruction by continuing firms, job creation among these firms is subdued in the first few years of the transition everywhere. The subsequent rise in continuing firm job creation occurs near the time of economic recovery, which arrives first in Hungary, followed by Romania, Lithuania, Georgia, Russia, and finally Ukraine.

Coming just after the accumulated misallocations of central planning, the transition might have been expected first to bring about a temporary period of extraordinarily high job reallocation. Following this massive industrial restructuring, reallocation rates would then converge to developed economy norms. Such a pattern would be consistent with the discussion in Section 2, for instance, of the accumulated misallocation under central planning and the rapid liberalization reducing costs of entry and adjustment at the beginning of transition. For the most part, however, total job reallocation rates during the transition lie in the general range (15 to 30 percent) found in nontransition economies (e.g., Davis and Haltiwanger, 1999; p. 26). The main exceptions are Hungary from 1990 to 1993 and Georgia in 2001-02 and 2004, when job reallocation is much higher. More rapid firm turnover accounts for the faster reallocation only to some extent, and most of it is rather due to higher creation and destruction among continuing firms. With the exception of Hungary (the Georgian time series is too short to draw conclusions), it appears that liberalization did not produce a big burst of job reallocation after the

[19] It is not possible to clean the longitudinal links in the Georgian data as thoroughly as in the other countries, since the data do not contain name or location information. The high Georgian firm turnover rates could at least partly reflect spurious exit and entry. But the job creation and destruction rates among incumbents are also highest in Georgia, so incomplete longitudinal links cannot be the full explanation.

negligible levels under socialism. Instead, job reallocation rates rose to developed economy levels and, with some fluctuations, have tended to stay within that range.

Finally, Figure 1d shows within-sector excess job reallocation rates, where sector refers to the 2-digit NACE industries described in Section 3. This type of reallocation is the most relevant for studying productivity growth decompositions, which we carry out within sectors, following the previous literature. Within-sector flows of jobs account for most job reallocation, generally 83 to 95 percent, which is very similar to the range of previous findings for other economies (Davis and Haltiwanger, 1999; p. 2726). These within-sector flows account for most job churning, and they are the focus of the productivity analysis to which we turn next.

### 4.2 Productivity Decompositions

We start our analysis of the contributions of reallocation to productivity growth by reviewing previous studies providing long-run FHK results for the U.K. and U.S., as developed economy benchmarks. Table 2 reproduces results from Disney, Haskel, and Heden (2003), Foster, Haltiwanger, and Krizan (2001), and Haltiwanger (1997). We add further decomposition of net entry, distinguishing proportionate entry using information on entry shares in these papers.[20] The decomposition period $k$ is 12 years for the U.K. and 10 years for the U.S.

These studies report a between continuing firm contribution to LP growth that is small in both countries (2.81 and 1.84 percentage points in the U.K. and U.S., respectively), and actually negative for U.S. MFP (-0.82). The FHK net entry terms (the sum of proportionate entry, disproportionate entry, and exit) are sizeable, which has been interpreted to suggest that firm turnover is an important contributor to their productivity growth. Employing our modified decomposition (3), however, we calculate that most of the FHK net entry term is accounted for by proportionate entry (73-86 percent, depending on country and LP or MFP). Taken together, exit and disproportionate entry contribute 4.91 and 1.84 percentage points to LP growth over these long periods in the U.K. and U.S., respectively, only 7-8 percent of aggregate LP growth. For MFP growth, the firm turnover contribution is even smaller: 1.61 percentage points in the U.K. and and 0.51 in the U.S. The total reallocation contribution (between, disproportionate entry, and exit) to MFP growth is actually negative for the U.S. These results suggest that productivity growth directly attributable to reallocation is quite modest in the U.K. and U.S.

Table 2 also shows long-run productivity decompositions for the whole transition period in Hungary, Lithuania, Romania, Russia, and Ukraine; $k$ varies from 10 to 15 years according to the availability of data. Total growth is substantial in Hungary, Romania, and Ukraine, while Russia's is relatively small for MFP and slightly negative for LP.[21] The within effects are large and positive in Hungary, Lithuania, Romania, and also for Ukrainian LP, but negative in Russia and for Ukrainian MFP. Hungary's between terms are negative, while Lithuania, Romania, Russia, and Ukraine's are positive and much larger than those reported for the U.K. and U.S.

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[20] These papers report only the net entry contribution, not distinguishing exit and entry effects separately, so they are grouped in Table 2.

[21] The totals for the transition countries are averages across sectors using initial-year weights. LP growth when applying final-year weights to final-year productivity is 62.92 percent in Hungary, 102.82 percent in Lithuania, 59.78 percent in Romania, 9.41 percent in Russia, and 70.75 percent in Ukraine, implying that intersectoral reallocation has contributed positively in Hungary, Russia, and Ukraine and negatively in Lithuania and Romania. MFP growth using output weights (as with the U.S. MFP decomposition) is 64.71 percent in Hungary, 111.51 percent in Lithuania, 132.38 percent in Romania, 22.41 percent in Russia, and 89.65 percent in Ukraine. As robustness checks, we have calculated the Russian totals using aggregate deflators, as well as different outlier exclusion rules, with similar results. The lower overall growth in Russia is not driven by any one sector, as nine of the nineteen Russian sectors exhibit negative total LP growth and seven have negative MFP growth.

The negative cross terms for Hungary, Lithuania, and Romania suggest that firms with growing productivity have falling employment shares.[22] In contrast, the positive cross-terms for Ukraine reflect a positive association of within-firm productivity growth with employment share change.

Turning to the firm turnover results in Table 2, the contribution of disproportionate entry is negative in Hungary and Romania and positive in Ukraine for both LP and MFP, while it is positive for LP and negative for MFP in Lithuania and Russia. The proportionate entry terms reflect the growth of average productivity and the entry share; they are generally large and positive except in Russia, where both productivity growth and entry shares are smaller. The exit contributions are positive everywhere, reflecting below-average productivity among exitors.

The FHK net entry terms, which include proportionate entry, are largest in Hungary, Lithuania, and Romania, followed by Ukraine, with Russia trailing far behind. That ordering is consistent with economists' observations that Eastern European growth has been driven by new firm entry to a much greater extent than the former Soviet Union (e.g., World Bank, 2002). But if the proportionate entry term is removed, as we have argued it should, then net entry actually contributes negatively to LP growth and negligibly to MFP growth in Hungary and Romania. In the former Soviet Republics, the contribution remains positive and, in some cases, large—larger than those reported for both the U.K. and U.S. The total reallocation contribution (not including proportionate entry) is largest in Ukraine, followed by Russia, Lithuania, Romania, and Hungary—in inverse order of reform progress as evaluated by international financial institutions.

Next we turn to comparisons across time periods as well as countries. Did central planners raise productivity through reallocation? Did more productivity-enhancing reallocation occur in partially reformed Hungary than in Soviet Russia during the 1980s? After reforms, did the contributions of reallocation to productivity growth increase sharply, and did they fall as reforms progressed? To address these and other questions about the dynamics of the productivity growth process, we show time plots of three-year LP growth decompositions in all six of our transition economies in Figure 2 (with the precise numbers provided in Appendix Table 2). Each dot in the figures represents the particular component for the three-year period ending in the year on the X axis.

Total growth and the within-continuing-firm contribution follow a "J-curve" pattern in each country with a long time series.[23] Hungary's decline begins earlier than in Russia and Ukraine, but its trough is much shallower, and the recovery begins several years earlier. While the within-firm contribution is the source of nearly all Hungary's productivity growth, it is important but not dominant elsewhere. Growth in Georgia, Lithuania, Russia, and Ukraine after Russia's 1998 financial crisis is impressive.[24] The cross term, plotted in Figure 2c, is nearly always negative in Hungary and Romania, consistent with the long-run decomposition. The cross term changes signs in Russia and Ukraine, however: in the early transition firms with growing productivity downsize less, but in later years they contract more. This pattern is

[22] Measurement error can also negatively bias the cross term. See Foster, Haltiwanger, and Krizan (2001).

[23] The within, cross, and proportionate entry terms in this decomposition should be treated with caution, because any measurement error in price changes (associated for instance with quality differences or high and volatile inflation) is reflected directly in these components. The reallocation terms do not suffer from the same measurement error problems to the extent that these errors are common across firms within an industry-period cell.

[24] The higher productivity growth in Georgia and Ukraine compared to Russia in the 2000s is consistent with those countries' official yearbook real production growth and employment series, which show average production growth between 2000 and 2004 of 12.4 percent in Georgia, 6.0 percent in Russia, and 14.7 percent in Ukraine, and employment growth of -10.4 percent in Georgia, -9.9 percent in Russia, and -11.7 percent in Ukraine.

inconsistent with some economists' expectation that restructuring would initially involve downsizing and only later innovations.

As shown in Figure 2d, the proportionate entry terms (and the FHK entry term) in the early years of Hungary's transition are highly volatile, showing very large and negative contributions in the 3-year periods ending in 1991 and 1992, then large and positive contributions in the periods ending in 1994 and 1995. These massive swings surely reflect a large volume of entry during a time when measured within-firm productivity growth is highly volatile and sensitive to imperfect price deflators, rather than changes in the quality of entrepreneurship. The term is relatively unimportant in Hungary in later years and in the other countries, with the exception of Georgia and Ukraine in the 2000s, where it is significantly positive.

The disproportionate entry contributions are also somewhat volatile, but much less so (note the different scale in Figure 2e compared to 2d). More strikingly, they are negative in most countries and time periods, with particularly large negative contributions in Hungary, Romania, and Lithuania. The exit contributions, plotted in Figure 2f, increase first in Hungary, but become largest in Georgia, Lithuania, and Ukraine from about 1998 onwards.

The total contribution of reallocation to productivity growth, including the between disproportionate entry, and exit components, is displayed for these 3-year periods in Figure 2g. During the central planning period the total contribution is virtually zero, and it is only slightly higher in partially reformed Hungary than in Soviet Russia and Ukraine (where the 3-year period 1989-1992 may be compared). Once the transition begins, the contribution increases sharply, rising from 0.52 in 1987-1990 to 11.75 percentage points of growth in 1992-1995 in Hungary, from -0.74 in 1989-92 to 5.33 in 1992-95 in Russia, and from 0.57 in 1989-92 to 2.75 in 1992-95 in Ukraine. The bulk of the gain comes from between continuing firm reallocation.

In Hungary, the reallocation contribution to productivity growth peaks in 1992-95, when it is the highest among the countries observed in that period. Romania's contribution is second highest, followed by Russia, and last by Ukraine; at this point, the ranking of countries by the magnitude of the contribution is the same as the rankings of their reforms by the international financial institutions. The moment passes quickly, however, as the Hungarian contribution drops quickly, and after 1994-97 it never exceeds 6 percentage points; following the 1999-2002 period it is essentially zero. Though Hungary has large contributions from between reallocation and exit in most years, its total reallocation contribution is reduced by a negative disproportionate entry term. The sum of the exit and disproportionate entry terms is also negative. In Romania, the total contribution remains relatively flat at around 10 percentage points, but a large negative disproportionate entry term tends to dominate the positive exit contribution as well. In both of these cases, firm turnover does not contribute to aggregate productivity growth, which is consistent with the presence of low entry barriers and high exit thresholds.

By contrast, the reallocation contribution rises to double-digit levels in Russia and Ukraine during the late 1990s. Continuing firm reallocation and exit contribute roughly equally to the rise in Russia, while more of it comes from continuing firm reallocation in Ukraine. Georgia has the highest reallocation contribution (45.33 percentage points in 2000-03), and its between and exit terms are both large. This shows that the productivity boom in these countries since Russia's 1998 financial crisis has not come simply from a restoration of incumbent firms' pre-transition output levels. These patterns may reflect higher entry barriers and lower exit thresholds in the less advanced reformers.

Lithuania and Romania, which are to some extent intermediate cases, also show significant reallocation contributions, but only through between continuing firm reallocation, and their levels are below those in Georgia, Russia, and Ukraine. The high between terms in Georgia and Ukraine in particular are symptomatic of exit barriers for unproductive firms. The fact that the exit terms begin to rise much later than the between terms, except in Hungary, is also consistent with there being exit barriers in the early transition in the slower reformers.

The substantial cross-country differences in these results are due neither to variation in industrial composition, as discussed further in the next section, nor to differences in coverage of the small enterprise sector (which may be lower in the Georgian, Lithuanian, and Russian registries compared to the other countries). As a check on whether the latter consideration influences the results, Appendix Figure 1 shows the total reallocation contribution from three-year LP decompositions with samples where employment of 100 or below is set to missing, entry is defined as the first year a firm has more than 100 employees, and exit is defined as the year after the last year the firm has more than 100 employees. The cross-country and over-time patterns in the results are qualitatively similar to the ones including all firms in Figure 2g.

The results are also not sensitive to the choice of period length and LP. The Appendix contains not only the underlying calculations for Figure 2, but also tables with five-year LP and three- and five-year MFP decompositions; the cross-country and cross-time patterns are similar. The disproportionate entry terms are higher and the exit terms are lower for MFP than LP, suggesting lower entrant and higher exitor capital intensity. Net entry is larger with MFP. The U.K. and U.S. five-year MFP total reallocation contributions are negative.[25]

The entry contributions deserve closer examination. Note that the disproportionate entry terms from the 3-year decompositions in Figure 2e combine entrants from three annual cohorts that may differ because of learning and selection processes. We show disproportionate entry terms for each cohort separately in Figure 3 and Appendix Table 6. Older cohorts contribute more positively to productivity growth than fresh entrants. If the current-year entrants were removed, nearly all of the net entry terms would be positive, including 14 of 17 in Hungary.

To measure the disproportionate contribution of entrant learning and selection to productivity growth within a two-year period, we calculate the difference between the contributions of a cohort at two-years-old and at entry in Figure 3d. The difference is nearly always positive, suggesting that productivity-enhancing learning and selection have made disproportionate contributions (above trend growth for the sector) to productivity growth. The effect has been stronger in Romania and even more so in Hungary than in Russia and Ukraine. Russian and Ukrainian entrants begin with similar productivity to incumbents, changing little as they age, while Hungarian and Romanian entrants are initially much less unproductive than incumbents, but the surviving entrants catch up to incumbents a year or two later. This suggests that Russia and Ukraine have higher entry barriers, while Hungary and Romania have more entrepreneurial experimentation, learning, and selection.[26]

We measure the extent to which entry cohorts catch up to incumbents via learning vs. selection by calculating two-year labor productivity decompositions for each entry cohort, where

[25] Results are also robust to the choice of weights (output versus employment) both within and across sectors.

[26] Though not displayed here, we have also calculated separate disproportionate entry terms for the longer-run decompositions, and even most older Hungarian cohorts perform only about as well as incumbents, and their contributions generally lag those of similarly-aged Russian and Ukrainian cohorts. Hungary's entrant performance is similar to that in the U.K.—results in Disney et al. (2000) show that only one entry cohort's productivity is higher than that of incumbents in the final year of its 1980-1992 decomposition. These results imply stronger age-productivity correlations in more advanced economies.

entrant labor productivity is deviated from the contemporaneous industry level. The within-firm productivity growth term is the learning, and selection is the between and exit terms. Figure 4 shows the averages among all entry cohorts since the transition began that are available in our data. The selection contributions are quite similar across countries, while learning is much greater in Hungary and Romania both relative to their selection contributions and compared to the learning terms in the other countries. Learning is less important than selection in Russia and especially Ukraine. These results are consistent with new firms facing lower costs of investment in the more advanced reformers (investment facilitates learning).

To summarize the results in this subsection, the rise in the reallocation contribution in the transition period relative to the socialist period is consistent with the hypothesis that market institutions facilitate productivity-enhancing reallocation, but the larger size of reallocation contributions in Georgia, Russia, and Ukraine compared to Lithuania, Romania, and especially Hungary, the U.K., and the U.S. is not. The timing of the rise in the reallocation contribution shows an initial burst followed by decline only in Hungary, but the burst is short-lived, peaking in the early 1990s and essentially disappearing after about 2000. In the other countries, we observe a steadier rise to levels that remain high and that exceed the Hungarian peak in Russia, Ukraine, and Georgia. Moreover, it is striking that even older entry cohorts in Hungary, Romania, and Lithuania do not contribute positively to productivity growth, and generally less than in Georgia, Russia, and Ukraine. The next section provides a deeper investigation into cross-country differences in the reallocation contribution.

### 4.3. Analyzing Differences in Productivity-Enhancing Reallocation

What factors lead to higher contributions of reallocation to productivity growth? We focus on three fundamental conditions: the volume of reallocation, the dispersion of productivity, and the correlation of reallocation and productivity differentials. We decompose the total contribution of reallocation, defined as the sum of the between, disproportionate entry, and exit terms in equation (4), into these three terms, measured as the standard deviation of employment share changes, the standard deviation of productivity, and correlation between share change and relative productivity. The difference in the reallocation contribution between sectors (or countries or time periods) *i* and *j* can be decomposed in the following way:

$$
\begin{aligned}
&\sum_e \left(p_{et-k} - P_{it-k}\right)\Delta s_{et} - \sum_f \left(p_{ft-k} - P_{jt-k}\right)\Delta s_{ft} = \\
&.5\times\left\{Corr\left(\Delta s_{et}, p_{et-k} - P_{it-k}\right) + Corr\left(\Delta s_{ft}, p_{ft-k} - P_{jt-k}\right)\right\}\times\left[.5\times\left\{N_i\sigma_{\Delta s_{et}} + N_j\sigma_{\Delta s_{ft}}\right\}\left\{\sigma_{p_{et-k}-P_{it-k}} - \sigma_{p_{ft-k}-P_{jt-k}}\right\}\right] \\
&+.5\times\left\{Corr\left(\Delta s_{et}, p_{et-k} - P_{it-k}\right) + Corr\left(\Delta s_{ft}, p_{ft-k} - P_{jt-k}\right)\right\}\times\left[.5\times\left\{\sigma_{p_{et-k}-P_{it-k}} + \sigma_{p_{ft-k}-P_{jt-k}}\right\}\times\left\{N_i\sigma_{\Delta s_{et}} - N_j\sigma_{\Delta s_{ft}}\right\}\right] \qquad (5) \\
&+.5\times\left\{N_i\sigma_{\Delta s_{et}}\sigma_{p_{et-k}-P_{it-k}} + N_j\sigma_{\Delta s_{ft}}\sigma_{p_{ft-k}-P_{jt-k}}\right\}\times\left\{Corr\left(\Delta s_{et}, p_{et-k} - P_{it-k}\right) - Corr\left(\Delta s_{ft}, p_{ft-k} - P_{jt-k}\right)\right\}
\end{aligned}
$$

The first term in this equation is the productivity dispersion component. Gaps in productivity across firms create the potential for productivity-enhancing reallocation—without these gaps, reallocation can have no productivity effect. Productivity dispersion can thus be considered a measure of "cleansing potential." The employment share change dispersion component is the second term. Ceteris paribus, the more reallocation occurs across firms, the more it can affect productivity growth. This can be thought of as reallocation intensity or volume. The third term is the reallocation-productivity correlation component. A positive correlation is essential for reallocation to be productivity-enhancing. The stronger the correlation, the more precise is the targeting of reallocation from less productive toward more productive firms. We first analyze each of the components, focused on the case of three-year periods and labor productivity, and then we report the results from decomposition (5).

One would expect productivity dispersion to display an inverse U-shaped pattern as a function of market reform. An abrupt shift in prices and markets may be advantageous for some firms but disadvantageous for others. Firms are unlikely to adapt equally well to the new market environment. New firms will enter and experiment, some with high and others with low productivity; as they learn, a selection process will tend to make them more homogenous. Exit will also reduce heterogeneity, but weaker firms may be allowed to survive in countries implementing only partial reform, while they are pushed out with more complete reform. Together, these forces imply an inverse-U shaped profile. Figure 5a presents the standard deviation of labor productivity using initial year productivity (except for entrants, whose productivity is measured in the final year—three years later in this three-year decomposition case).[27] Productivity dispersion is very similar across the five countries where we can measure it on the eve of the transition, as well as to the United Kingdom.[28] It rises by 60-240 percent after the introduction of reform, then plateaus. The fact that it plateaus suggests that cleansing of less productive firms is sufficient to prevent a further increase in dispersion, but not enough to bring it down to levels found in developed market economies. It both increases and plateaus earliest in Hungary and latest in Ukraine. In the later transition heterogeneity is highest in Ukraine, followed by Georgia, Lithuania, Russia, Romania, and Hungary, roughly in inverse order of reform progress in the early transition.

This massive productivity dispersion increase could simply be an uncovering of pre-existing gaps between firms that were hidden due to features of central planning such as fixed input and output prices and absence of competition. Alternatively, the physical and human capital needed to perform well in centrally planned and market systems may be very different. The former would suggest little change in firms' relative productivity rankings and the latter substantial change. To investigate this we calculate the correlation between the productivity ranks of continuing firms across three-year periods. Figure 5b shows one minus this correlation. Prior to the transition, firm ranks change very little, though more in Hungary than Russia (perhaps reflecting the partial reform process in Hungary). A large amount of rank change occurs at the beginning of the transition, then the pace falls somewhat. Romania's rank change is usually highest, followed closely by Lithuania and Georgia, while Hungary, Russia, and Ukraine's are somewhat lower during the later years. The large increase in rank change coincides with the rise in productivity dispersion, suggesting that the greater dispersion is not just an uncovering of inherited gaps.

Similar to the job reallocation analysis in Section 4.1 are the results in Figure 5c for the standard deviation of employment share changes across three-year periods (multiplied by the number of firms appearing in one or both years). Within-sector reallocation increases dramatically with reform in Hungary, but much more gradually in Russia and Ukraine. During the later years Georgia, Hungary, and Romania have the highest volumes, about twice as large as in Russia.

Privatization and improved corporate governance should reorient firms toward profit maximization, implying that successful firms should strive to increase market share and unsuccessful ones should contract. Competition should also force the weaker firms to contract and exit. These factors would suggest that targeting of reallocation should improve with market reform. On the other hand, high reallocation volume sparked by reform could result in weaker

[27] Appendix Table 7 shows the numbers behind Figures 4 and 5a-5c.
[28] Disney et al. (2003) report labor productivity variance of 0.44 in the United Kingdom manufacturing sector in 1992, which translates into a standard deviation of 0.66.

average targeting. The employment share change-productivity correlation across three-year periods is displayed in Figure 5d. The Russian and Hungarian correlations fall in the early transition compared to the late central planning period. Their correlations then rise, as does Ukraine's. Russia and Ukraine's improvements in targeting are much greater than Hungary's, however. Reallocation in Russia, Ukraine, and Georgia has been quite well targeted in recent years, and Lithuania and Romania's reallocation is also targeted more toward productive firms. In contrast, Hungary's reallocation-productivity correlation has hovered around zero.

We next analyze the extent to which the three components account for differences between the reallocation contributions across countries in the early transition (1992-1995) in Table 3a. As with the productivity growth decompositions, the results are averages over the 19 sectors, weighted by employment. Here the employment shares are those of the second country listed. A fourth term, industry share effect, is the residual between the actual difference in reallocation contributions using each country's own weights and the difference when using the second-listed country's weights for both countries. Hungary's higher reallocation contribution in the early transition can be explained mainly by its higher reallocation volume, but also to some extent by having higher productivity dispersion than Russia and Ukraine. Hungary's reallocation contribution would have been over four percentage points higher had its targeting of the reallocation been as good as in Romania, Russia, and Ukraine.

Decompositions of the differences in reallocation contributions across countries in the most recent period are shown in Table 3b. Hungary's fall from having the highest to the lowest reallocation contribution to productivity growth can be accounted for by a reduction in the size of the gap between Hungary's reallocation volume and that of the other countries, higher productivity dispersion in the other countries, and especially by much better targeting of reallocation in the direction of more productive firms elsewhere. More precise targeting leads to 7-42 percentage points higher reallocation contributions in the other countries relative to Hungary. Romania has a higher reallocation contribution than Lithuania mainly due to higher reallocation volume, while Georgia, Russia, and Ukraine have higher contributions due to better targeting. The lower reallocation contribution in Romania relative to Georgia, Russia, and Ukraine follows a similar pattern to Hungary's, where Romanian reallocation volume is higher, but productivity dispersion is lower, and targeting is much worse. Russia's contribution is lower than in Georgia and Ukraine because of lower reallocation volume and productivity dispersion.

The components of the reallocation effect may be interrelated. High productivity dispersion could facilitate the targeting of reallocation (entrepreneurs will have better information about whether they should increase or decrease market share) and may encourage a higher volume of reallocation, since reallocation gains are higher. Good targeting and high reallocation volume can lower productivity dispersion (the less productive firms downsize and exit). High reallocation volume may hinder targeting and produce higher productivity dispersion, which would be consistent with hyperkinesis (Caballero and Hammour, 1996).

We test whether such associations exist in the data in the regression analysis shown in Table 4. The regressions exploit variation within industries and countries across time. The observations are industry-country-year cells for modified versions of components of the reallocation contribution to three-year labor productivity growth.[29] Industry, country, and year

[29] Note that the initial incumbent productivity dispersion measure here is not the same as the productivity dispersion measure that is a component of the reallocation contribution, as subsequent entrants are excluded from initial incumbent productivity dispersion. Including entrants in initial productivity dispersion could introduce a simultaneity problem, as employment share change dispersion will be higher if entry is higher, and higher entry is

effects are included as controls. The first column shows that initial incumbent productivity dispersion is associated with significantly higher reallocation volume. The coefficient implies that moving from Ukraine's incumbent productivity dispersion in 1989 to that in 1999 would yield 99.6 percent higher employment share change dispersion, which is close to the same amount that Ukraine's employment share change dispersion actually increased during the period. As shown in column 2, initial incumbent productivity dispersion is associated with better targeting of reallocation toward more productive firms. According to the coefficient, moving from Ukraine's incumbent productivity dispersion in 1989 to that in 1999 results in 0.076 higher correlation between employment share change and productivity, which is nearly as much as Ukraine's correlation increased in reality. Change in incumbent productivity dispersion can be thought of as a measure of the amount of cleansing within the group: if less productive firms exit, then productivity dispersion should fall.

The regression in column 3 tests whether incumbents' reallocation volume and targeting reduce their productivity dispersion. Both are negatively associated with incumbent productivity dispersion, though targeting is not quite statistically significant. Increasing Ukraine's reallocation volume among incumbents in 2002-2005 to that in Hungary at the same time would yield a 0.020 drop in productivity dispersion. Replacing Hungary's incumbent share change-productivity correlation in 2002-2005 with that of Ukraine would reduce incumbent productivity dispersion by 0.010. This suggests that it would take many years of reallocation volume at Hungary's rate and Ukraine's precision for Ukraine's productivity dispersion to fall to Hungary's level (Ukraine's productivity dispersion in 2005 among firms producing since 2002 is 0.48 higher than Hungary's). Column four, which includes a squared term for reallocation volume, suggests diminishing returns for reallocation volume to reduce productivity dispersion. None of the countries are in the range where the marginal effect of reallocation volume on productivity dispersion change is positive, however, so hyperkinesis appears not to be a major factor.

## 5. Conclusion

This paper measures the contribution of employment reallocation to aggregate productivity growth using manufacturing census data in Georgia, Hungary, Lithuania, Romania, Russia, and Ukraine. Reallocation contributes negligibly to productivity growth during the socialist period, although more in partially reformed Hungary than centrally planned Soviet Russia. After reform, reallocation contributes much more than previously reported for the United Kingdom and United States. In Hungary, the fastest reformer in this group, the magnitude of the contribution is high in the early transition years, but then declines to nearly zero by the late 1990s. In Ukraine and Russia, the slowest reformers, the contribution is relatively low initially and grows significantly as the transition progresses, reaching very high levels by international standards in both these countries and Georgia. In Romania and Lithuania, the intermediate reformers, the situation is likewise intermediate, with moderate rises in the contribution that tend to be sustained. In all countries, reallocation between continuing firms is strongly productivity-enhancing, but firm turnover is productivity-enhancing only in Georgia, Russia, Ukraine, and sometimes Lithuania.

The patterns of differences across countries and over time are not due to differences in data definitions, samples, and procedures, nor to decomposition methods, productivity

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likely associated with greater productivity dispersion among the entrants. The productivity dispersion change regressions do not include entrants in either the dependent or independent variables, as the focus here is on the cleansing process among incumbents, not entrants. Again, greater entry (and thus reallocation volume when including entry) is likely to lead to temporarily higher productivity dispersion.

measurement, or industrial composition. They appear to be robust along all these dimensions. However, they are not fully consistent with the standard presumption that reform increases productivity-enhancing reallocation. Reallocation has become more productivity-enhancing since the transition began, and Russia and Ukraine's reallocation contributions have increased as more reform has been implemented. But the hypothesis doesn't explain why more gradually reforming Georgia, Russia, and Ukraine have experienced reallocation contributions so much higher than faster reforming Hungary, Lithuania, and Romania's. The relationship between reform and productivity-enhancing reallocation thus appears to be inverse U-shaped. The results do not support the presence of hyperkinesis either, as Russian and Ukrainian reallocation volume and its contribution to productivity increase in tandem, and Georgia's reallocation volume is also both high and productivity-enhancing.

What then can explain why the reallocation contribution is higher in the slower reformers? As reform is introduced, firms face a new environment; some adapt better than others, creating productivity gaps. High inflation and lingering price controls raise uncertainty about productivity of entrants and incumbents, and state subsidies raise costs of exit (by lowering fixed costs of operating). The longer an economy remains in a state of incomplete liberalization and stabilization, with high adjustment costs, the more productivity dispersion rises, resulting in greater potential for gains from cleansing. Slower initial reallocation volume leads to a later high contribution to productivity not because slower reallocation creates better matches, but rather because the slow pace of reallocation allows productivity gaps to widen. In contrast to the transition economies, the low adjustment cost economies of the U.K. and U.S. have been continually swept clean of less productive firms, reducing the scope for reallocation to contribute to productivity growth. This story is consistent with standard models of industry dynamics, and it is reinforced by our regression results relating difference components of the reallocation contribution: incumbent productivity dispersion tends to raise reallocation volume and the quality of targeting, while higher reallocation volume and better targeting tend to reduce incumbent productivity dispersion.

Contrary to the expectations of some economists, we find that the measured contribution of initial entrants to productivity growth is negative, particularly in the advanced reformers.[30] The lower entry and exit barriers in the more liberalized reformers are associated with greater experimentation: more low-productivity firms enter, pulling down the entry contribution to productivity growth. The learning and selection process among the new entrants is more intensive in advanced reformers, though, so the surviving entrants achieve similar productivity levels as surviving incumbents within a year or two. The entry contribution in advanced reformers is also reduced by the faster within-firm productivity growth among surviving advanced-reform-country incumbents, so catching up to surviving incumbents is a greater achievement under these circumstances.

An important lesson emerging from this analysis is that a large contribution of reallocation to aggregate productivity growth is a second-best outcome. It would have been better if some firms had not had such difficulty adapting to the new market environment and experienced precipitous productivity drops, or if they had exited before falling so far behind. Indeed, the relationship between reform and the within-firm productivity contribution appears to be U-shaped—Hungary, for example, has experienced higher overall productivity growth during the transition than the other countries, and most of it was achieved through within-firm

[30] It is important to reiterate that reallocation could also contribute indirectly, as entrants and expanding incumbents could discipline other incumbents to increase productivity or exit. This is a topic we leave for future research.

productivity growth.[31] Given that the productivity gaps have formed, though, the slower reformers would be much worse off if the reallocation they have experienced had been blocked. The continued presence of these gaps suggests that the potential exists for much more reallocation-induced productivity growth well into the future.

It would be difficult to discern these lessons from the conventional measures of the contributions of entry and net entry employed in previous studies. At face value, the standard entry term suggests that entry is an important source of productivity growth in the U.K. and U.S., and that it is more important in Hungary and Romania than in Ukraine or Russia. As is evident in our results, however, the conventional measures are highly sensitive to the share of new entrants and trend productivity growth. We address this problem by decomposing the standard entry term into proportionate and disproportionate entry, and we argue that the latter is the most useful for evaluating entry's contribution. The results show that entrant productivity is actually lower on average than that of surviving incumbents in several of the countries, particularly over shorter decomposition periods. By calculating separate disproportionate entry terms for each entry cohort, we show that the disproportionate entry contribution of all cohorts together is reduced by the most recent cohorts; older cohorts tend not to make negative contributions to productivity growth. We also find that the higher Russian and Ukrainian overall disproportionate entry contributions are due to initial productivity levels that are similar to those of incumbents, but more intensive learning and selection processes in Hungary and Romania enable entrants, whose initial productivity falls significantly short of incumbents, to catch up within two years. This stark contrast may reflect differences in entry and investment costs associated with the business environment in the former Soviet versus the EU member states.

We decompose the total reallocation contribution to productivity into productivity dispersion (cleansing potential), reallocation volume, and targeting of the reallocation toward more productive firms. The decomposition analysis illustrates how productivity-enhancing reallocation is not simply a matter of having high reallocation volume. Despite their significantly lower volume, Georgia, Russia, and Ukraine have had much higher reallocation contributions to productivity growth than Hungary, Lithuania, and Romania because of larger productivity gaps and much better targeting. Finally, we take advantage of within-industry variation across time to identify relationships among the different components of productivity-enhancing reallocation, which provides support for the hypothesis that productivity dispersion encourages reallocation volume and facilitates targeting, while volume and targeting reduce dispersion.

We have found that the transition economy reforms and recessions were characterized by highly idiosyncratic shocks across firms, which can help explain the rise in productivity-enhancing reallocation. It would be useful to conduct this analysis in other economies to see if it is more generally true. Our reallocation contribution decomposition could also help explain differences in the contribution of productivity-enhancing reallocation to productivity growth across time, sectors, regions, and countries. One might expect variation in technologies and institutions (e.g., labor market and corporate governance institutions) to lead to differences in productivity dispersion, reallocation volume, and the quality of reallocation targeting.

[31] If firms with lower productivity growth or with less potential for future productivity growth exit, the firms that remain will have higher average within-firm productivity growth, which could help explain Hungary's superior within-firm productivity growth.

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**Figure 1: Annual Job Reallocation Rates**

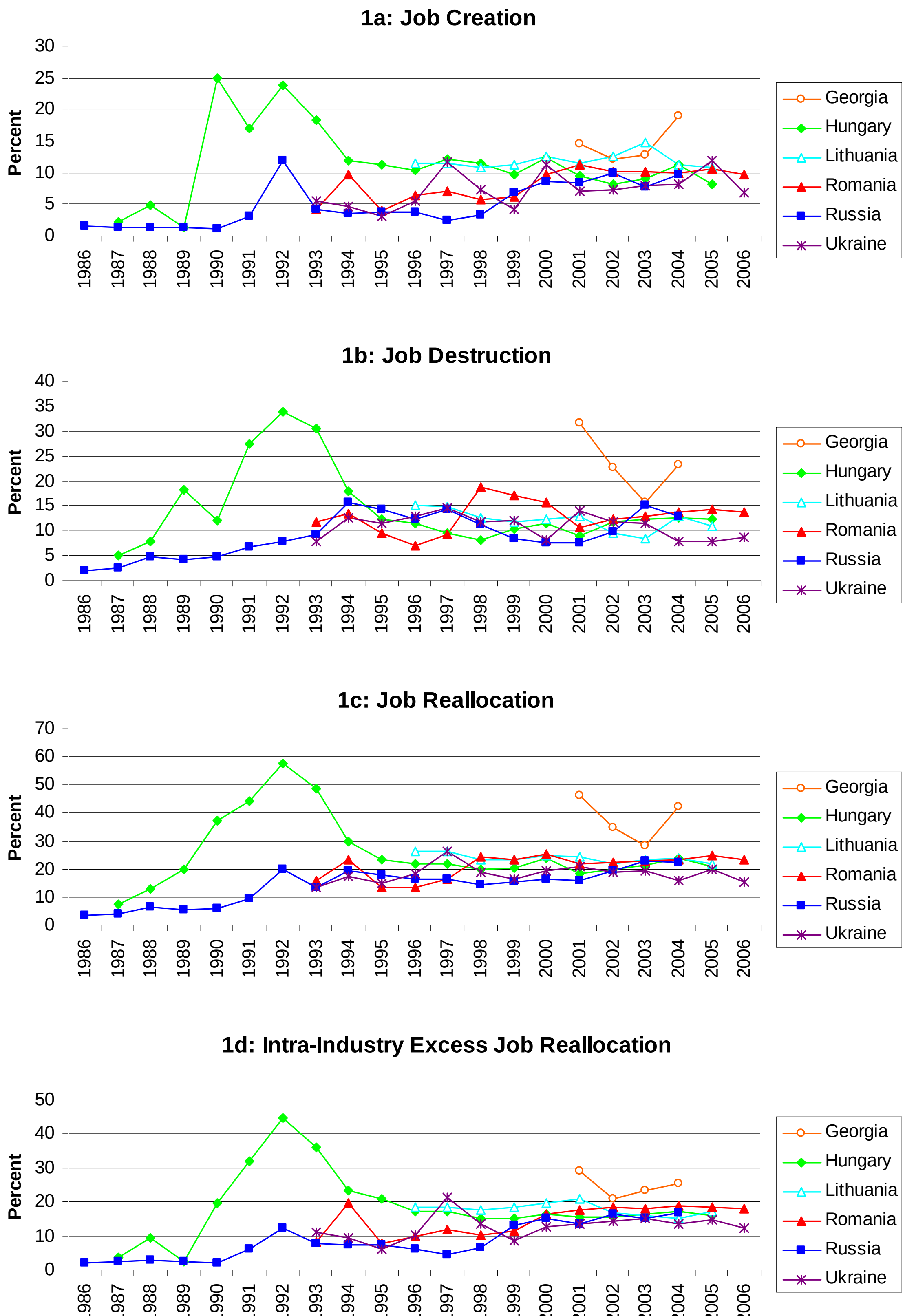
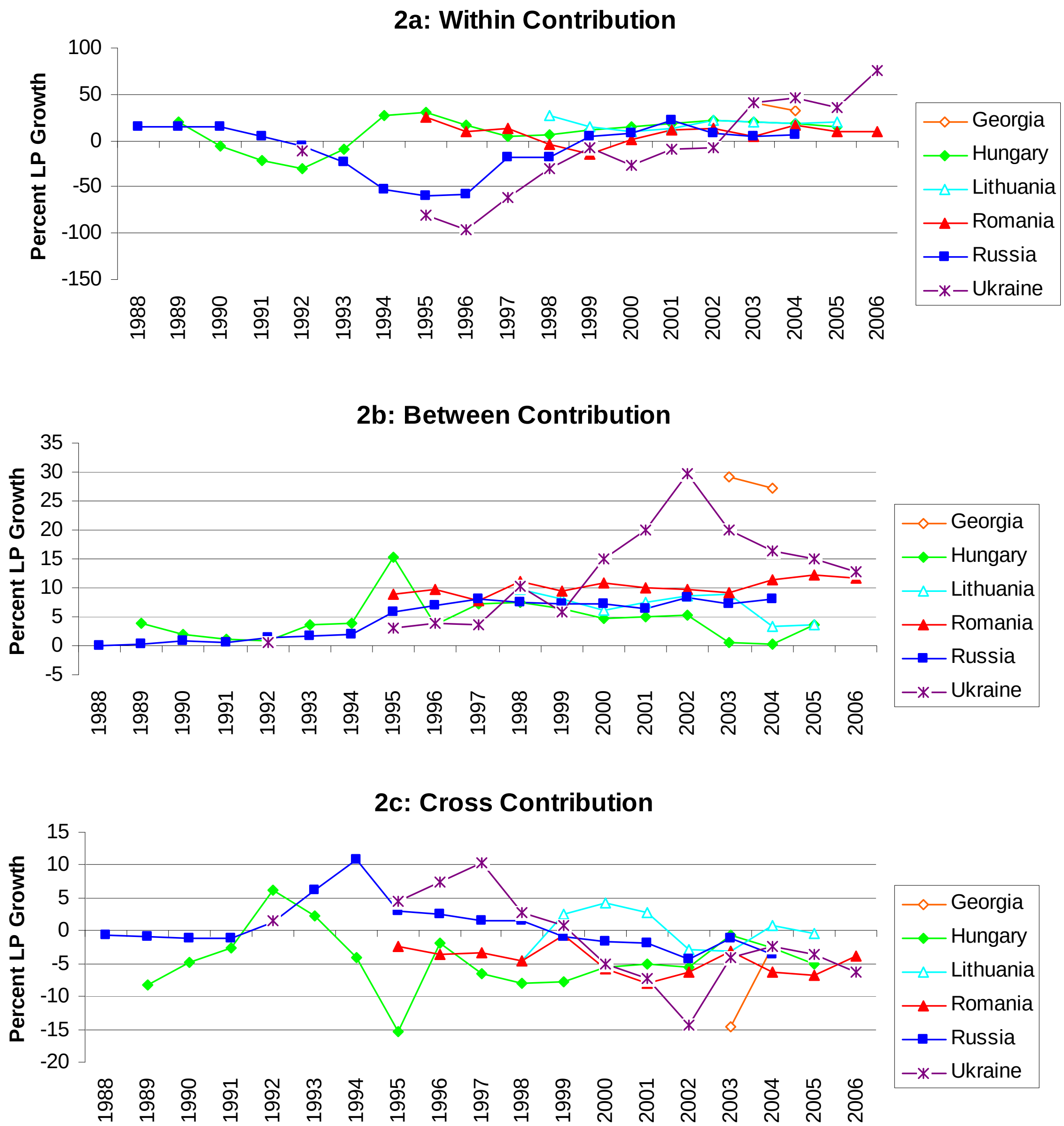
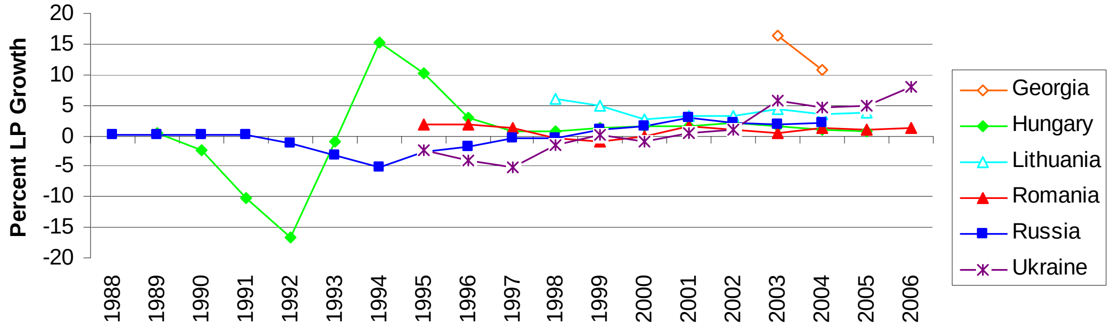


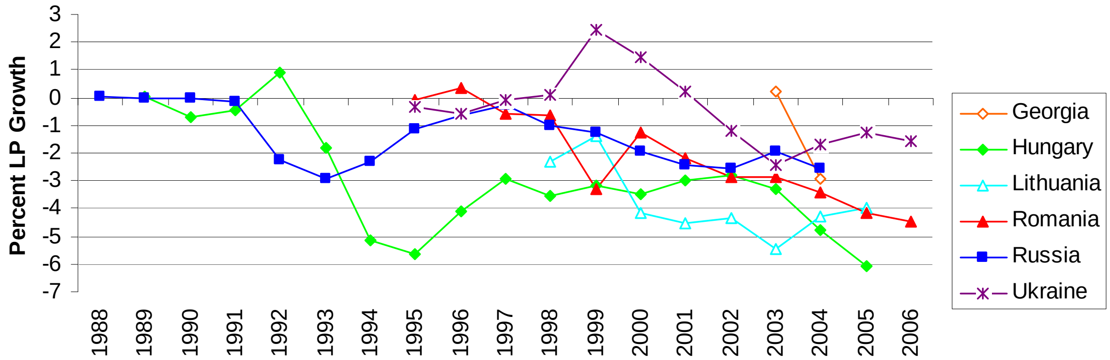
**Figure 2: Three-Year Labor Productivity Decompositions**



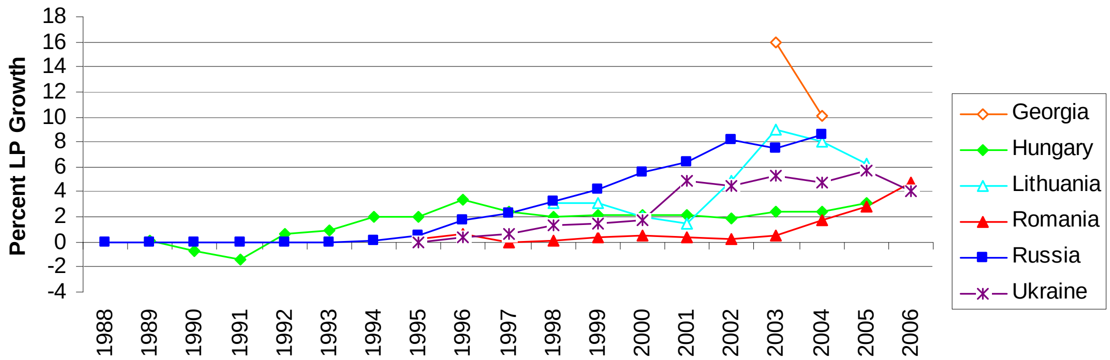
## 2d: Proportionate Entry Contribution

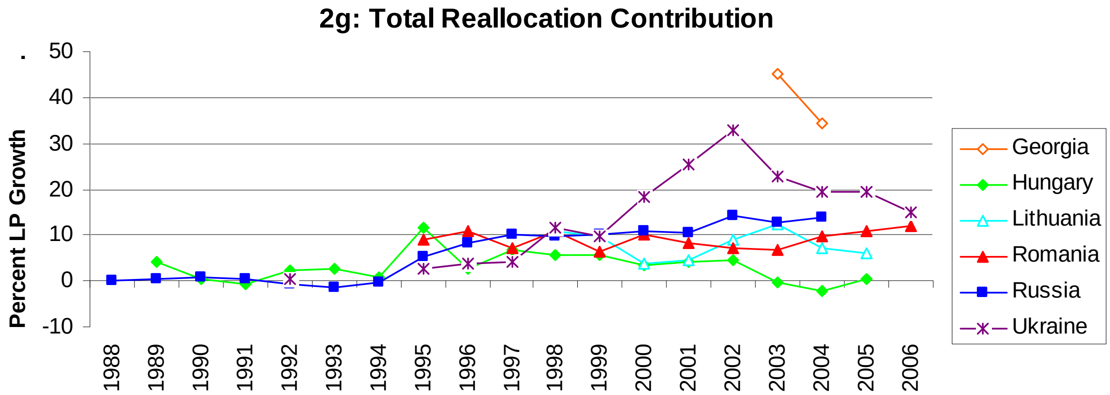



## 2e: Disproportionate Entry Contribution



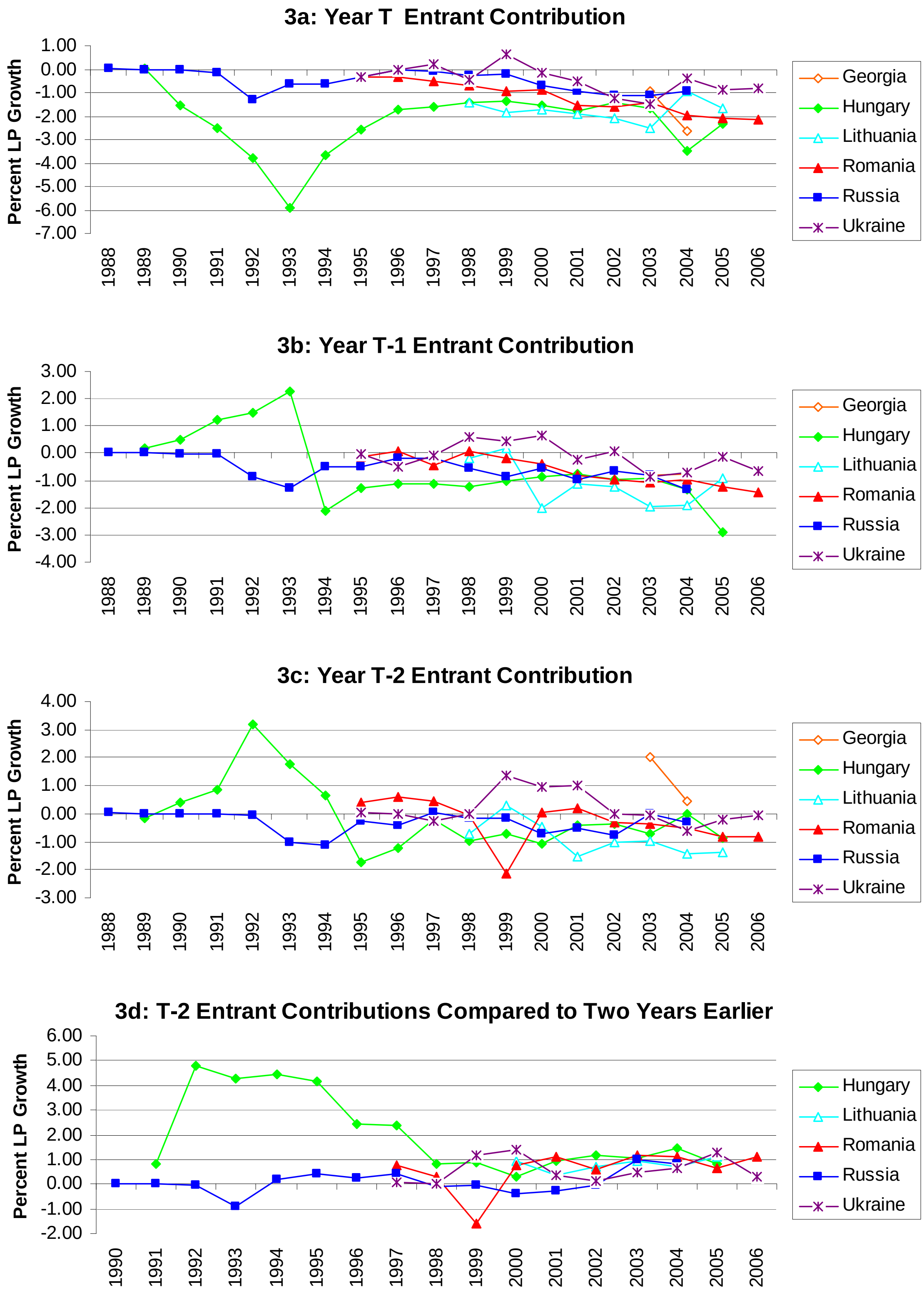

## 2f: Exit Contribution





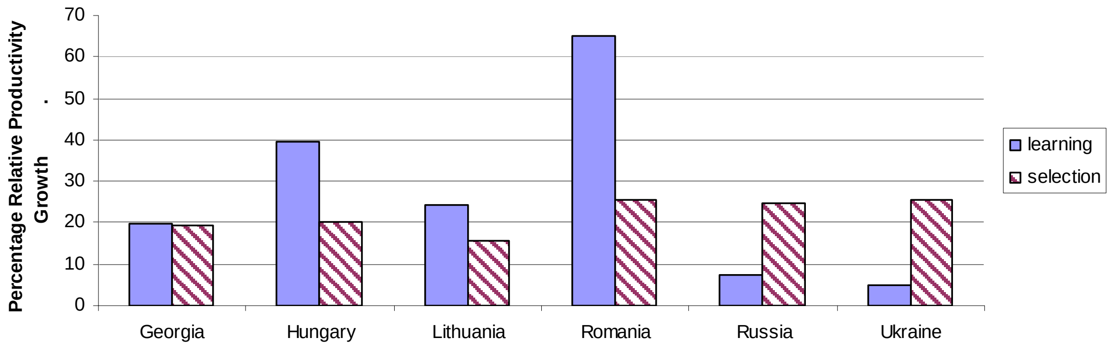

Note: The numbers behind these figures are in Appendix Table 2. Total reallocation contribution is defined as between contribution plus disproportionate entry contribution plus exit contribution.

## Figure 3: Disentangling the Entry Contribution



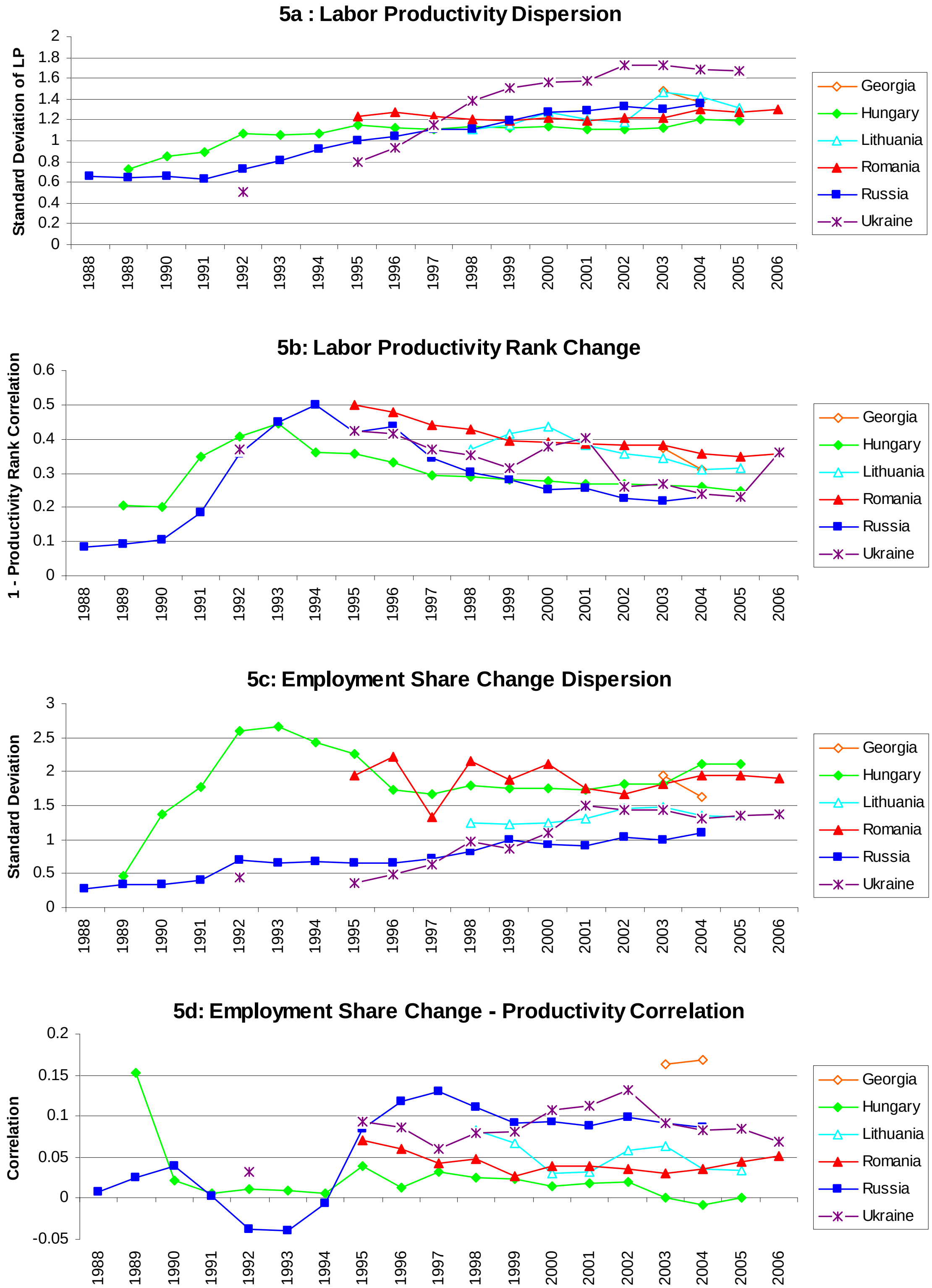

Note: These are disproportionate entry terms separately for each of the three entry cohorts in the three-year LP decompositions. Figure 11 takes the difference between the year T-2 contributions and what they were two years earlier as year T contributions. The numbers behind these figures are in Appendix Table 5.

## Figure 4: Learning and Selection Among Entrants Over Two Years




Note: Learning is the within term, and selection is the sum of the between and exit terms from a two-year labor productivity growth decomposition (minus entry terms) for fresh entrants, where firms' labor productivity is deviated from the contemporaneous industry level. These are average numbers over all two-year periods after the beginning of the transition (i.e., starting with 1991 entrants in Hungary, 1993 entrants in Romania, Russia, and Ukraine, and all available cohorts in Georgia and Lithuania).

## Figure 5: Reallocation and Labor Productivity Components




Note: Three-year averages using the samples for the three-year labor productivity decompositions. The year on the x-axis refers to the final year in the decomposition. The numbers for these figures are shown in Appendix Table 6.

## Table 1: Mean Output, Employment and Capital Stock in the First and Last Years of Analysis

| | Employment | | Output or Sales | | Capital Stock | |
|---|---|---|---|---|---|---|
| | First year | Last year | First year | Last year | First year | Last year |
| Georgia | 30.9 | 23.9 | 302.5 | 526.2 | 442.0 | 342.4 |
| | (122.9) | (87.6) | (1,517.6) | (3,291.5) | (3935.4) | (2,033.3) |
| Hungary | 700.1 | 23.7 | 7,054.2 | 594.5 | 2,364.1 | 190.0 |
| | (1,181.0) | (138.7) | (22,492.0) | (14,377.8) | (9,372.5) | (3,514.5) |
| Lithuania | 131.1 | 45.1 | 6,465.5 | 7,296.8 | 3,362.0 | 2,712.6 |
| | (404.8) | (148.7) | (30,697.9) | (158,200.7) | (16,159.0) | (28,307.3) |
| Romania | 257.3 | 35.3 | 105,167.7 | 38,879.0 | 835,676.5 | 22,640.7 |
| | (1062.4) | (182.5) | (682,720.1) | (605,725.2) | (3,365,040.2) | (327,126.2) |
| Russia | 819.9 | 366.9 | 520.4 | 525.5 | 355.3 | 827.6 |
| | (2,637.7) | (1,461.9) | (1499.8) | (5,674.7) | (1,439.6) | (18,959.7) |
| Ukraine | 783.2 | 85.8 | 53.9 | 13.2 | 37.2 | 17.2 |
| | (1,865.9) | (764.1) | (170.5) | (201.4) | (168.6) | (418.9) |

Note: The first year of analysis is 1985 in Russia, 1986 in Hungary, 1989 in Ukraine, 1992 in Romania, 1995 in Lithuania, and 2000 in Georgia; the last year is 2004 in Georgia and Russia, 2005 for Hungary and Lithuania, and 2006 for Romania and Ukraine. Employment is the average annual number of all registered employees, except in Russia, where it excludes personnel working in non-industrial divisions. Output or sales refers to sales in Georgia, Hungary, Lithuania, Romania, and post-2003 Ukraine, and to value of production in Russia and pre-2004 Ukraine. Capital stock is the book value of fixed assets. Output or sales and capital stock are expressed in constant final-year prices (thousands of 2004 GEL for Georgia, millions of 2005 HUF for Hungary, thousands of 2005 LTL for Lithuania, millions of 2006 ROL for Romania, millions of 2004 RUB for Russia, and millions 2006 UAH for Ukraine). Standard deviations are shown in parentheses.

## Table 2: Long-Run Productivity Growth Decompositions

| | Total | Within | Between | Cross | Prop. Entry | Disprop. Entry | Exit |
|---|---|---|---|---|---|---|---|
| United Kingdom | | | | | | | |
| 1980-1992 LP | 70.17 | 33.68 | 2.81 | -0.70 | 29.47 | 4.91* | |
| 1980-1992 MFP | 13.49 | 0.67 | 2.02 | 3.51 | 5.67 | 1.61* | |
| United States | | | | | | | |
| 1977-1987 LP | 23.02 | 17.03 | 1.84 | -2.53 | 4.83 | 1.84* | |
| 1977-1987 MFP | 10.24 | 4.92 | -0.82 | 3.48 | 2.15 | 0.51* | |
| Hungary | | | | | | | |
| 1990-2005 LP | 53.31 | 29.31 | -1.67 | -14.67 | 43.13 | -4.55 | 1.76 |
| 1990-2005 MFP | 37.94 | 8.34 | -1.85 | 0.41 | 30.97 | -0.41 | 0.48 |
| Lithuania | | | | | | | |
| 1995-2005 LP | 109.63 | 50.81 | 4.41 | -1.99 | 50.45 | -6.43 | 12.39 |
| 1995-2005 MFP | 107.48 | 44.35 | 8.45 | -7.21 | 50.35 | 2.55 | 9.01 |
| Romania | | | | | | | |
| 1992-2006 LP | 86.09 | 51.10 | 7.22 | -13.63 | 41.85 | -3.33 | 2.88 |
| 1992-2006 MFP | 89.75 | 46.88 | 4.26 | -8.67 | 46.12 | -1.50 | 2.66 |
| Russia | | | | | | | |
| 1992-2004 LP | -1.98 | -11.69 | 7.12 | 1.22 | -2.58 | -1.85 | 5.80 |
| 1992-2004 MFP | 9.26 | -2.81 | 6.23 | -2.18 | 1.88 | 2.24 | 3.90 |
| Ukraine | | | | | | | |
| 1992-2006 LP | 67.46 | 17.64 | 7.74 | 11.21 | 24.65 | 3.24 | 2.98 |
| 1992-2006 MFP | 54.21 | -0.21 | 7.39 | 16.69 | 22.98 | 4.34 | 3.02 |

Note: These calculations are based on Equation (4) in the text. The Exit term is $-\sum_{e\in X} s_{et-1}\left(p_{et-1}-P_{it-1}\right)$, so a positive value means a positive contribution to productivity growth. The U.K. results are based on Disney, Haskel, and Heden (2003), and the U.S. numbers on Haltiwanger (1997) and Foster, Haltiwanger, and Krizan (2001). These papers apply a similar equation (except that the Entry and Exit components are combined, and Proportionate Entry is not distinguished) to establishment data, using base-year worker-hours (U.K. LP and MFP and U.S. LP) or output (U.S. MFP) as weights; the labor measure is worker-hours. The Proportionate Entry numbers for the U.S. and U.K. are our calculations based on figures available in the text of these papers.

**Table 3a: Decomposition of Cross-Country Reallocation Contribution Differences in 1992-1995**

| | Productivity Dispersion Component | Employment Share Change Component | Correlation Component | Industry Share Component | Total Reallocation Contribution Difference |
|---|---|---|---|---|---|
| Romania–Hungary | 1.18 | -7.61 | 4.78 | -0.93 | -2.58 |
| Russia–Hungary | -1.39 | -9.32 | 4.46 | -0.17 | -6.43 |
| Ukraine–Hungary | -3.22 | -11.84 | 6.92 | -0.85 | -9.00 |
| Russia–Romania | -1.48 | -6.92 | 4.91 | -0.36 | -3.84 |
| Ukraine–Romania | -5.03 | -15.02 | 14.68 | -1.05 | -6.42 |
| Ukraine–Russia | -1.13 | -2.75 | 1.51 | -0.21 | -2.58 |

Note: These are decompositions of the differences in the total reallocation contribution to three-year labor productivity growth in the two countries in 1992-1995, applying equation (5). The numbers are percentage points of productivity growth.

## Table 3b: Decomposition of Cross-Country Reallocation Contribution Differences in Latest Period

| | Productivity Dispersion Component | Employment Share Change Component | Correlation Component | Industry Share Component | Total Reallocation Contribution Difference |
|---|---|---|---|---|---|
| Georgia–Hungary 2001-2004 | 2.92 | -12.46 | 42.31 | 3.90 | 36.66 |
| Lithuania–Hungary 2002-2005 | 0.40 | -3.12 | 7.38 | 0.66 | 5.33 |
| Romania–Hungary 2002-2005 | 0.69 | -0.96 | 13.07 | -2.35 | 10.45 |
| Russia–Hungary 2001-2004 | 2.10 | -9.65 | 27.59 | -3.86 | 16.17 |
| Ukraine–Hungary 2002-2005 | 5.09 | -6.18 | 25.42 | -5.42 | 18.91 |
| Georgia–Lithuania 2001-2004 | 1.63 | 3.61 | 23.08 | -0.95 | 27.36 |
| Romania–Lithuania 2002-2005 | -0.25 | 3.81 | 1.43 | 0.13 | 5.12 |
| Russia–Lithuania 2002-2005 | -0.25 | -2.02 | 15.70 | -6.56 | 6.87 |
| Ukraine–Lithuania 2002-2005 | 3.44 | 2.33 | 14.24 | -6.43 | 13.58 |
| Georgia–Romania 2001-2004 | 3.26 | -5.87 | 19.27 | 8.10 | 24.76 |
| Russia–Romania 2001-2004 | 0.54 | -6.69 | 13.98 | -3.56 | 4.27 |
| Ukraine–Romania 2003-2006 | 3.55 | -4.14 | 8.76 | -4.96 | 3.21 |
| Georgia–Russia 2001-2004 | 2.99 | 5.03 | 7.59 | 4.89 | 20.50 |
| Ukraine–Russia 2001-2004 | 3.26 | 3.67 | -0.64 | -0.74 | 5.55 |
| Georgia–Ukraine 2001-2004 | -7.02 | 5.25 | 20.97 | -4.26 | 14.94 |

Note: These are decompositions of the differences in the total reallocation contribution to three-year labor productivity growth in the two countries over the stated time period, applying equation (5). The numbers are percentage points of productivity growth.

## Table 4: Incumbent Firm Cleansing Potential and Volume Regressions

| | Employment Share Change Dispersion | Employment Share Change-Productivity Correlation | Incumbent Productivity Dispersion Change | Incumbent Productivity Dispersion Change |
|---|---|---|---|---|
| Incumbents' Initial Productivity Dispersion | 0.830***<br>(0.152) | 0.063***<br>(0.018) | | |
| Incumbent Employment Share Change-Productivity Correlation | | | -0.142<br>(0.089) | -0.147*<br>(0.088) |
| Incumbent Employment Share Change Dispersion | | | -0.030***<br>(0.009) | -0.067***<br>(0.019) |
| Incumbent Employment Share Change Dispersion Squared | | | | 0.007**<br>(0.003) |
| $R^2$ | 0.408 | 0.251 | 0.369 | 0.372 |

Note: N = 1,330. The units of observation are country-industry-year cells, pooling data from Georgia, Hungary, Lithuania, Romania, Russia, and Ukraine. Each regression also contains industry, country, and year effects. Standard errors adjusted for clustering on country-industries are in parentheses. * = significant at the 10 percent level, ** = significant at the 5 percent level, and *** = significant at the 1 percent level. Employment change dispersion, employment change-productivity correlation, and productivity dispersion change are over three-year periods. Change in productivity dispersion is defined as $\frac{\left(\sigma_{p_{et}-P_{it}} - \sigma_{p_{et-3}-P_{it-3}}\right)\times 2}{\left(\sigma_{p_{et}-P_{it}} + \sigma_{p_{et-3}-P_{it-3}}\right)}$. The dependent variables in the first two columns include entrant activity.