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Firm heterogeneity and endogenous regional disparities

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Abstract

We exploit the census of Romanian firms in order to provide a microfounded analysis of the sources of regional disparities in the country during the transition period, 1996–2001. To this extent, we adapt to the regional case a decomposition of firm-level output/value added dynamics based on semi-parametric productivity estimates. The methodology, robust to different techniques of TFP estimation, allows us to analyse the sources of regional disparities controlling for the heterogeneity in firms' characteristics. We find that the emergence of regional disparities is to a large extent endogenous to the interaction between the restructuring activity of incumbent heterogeneous firms and the initial distribution of economic activities. A lesser role is played by the standard drivers of firms' and workers' cross-regional reallocation.

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1. Introduction

A large body of economic literature has analysed the issue of regional inequalities under different perspectives. So far, the main lines of research have highlighted the role of cross-regional differences in factor endowments and market access as factors driving regional disparities. Very little attention has instead been paid to the role of firm heterogeneity and cross-firms reallocation of factors in this context. And yet, at least in principle, firm-level sources of inequalities might be expected to have a non-negligible influence on regional dynamics.

At this purpose, imagine two identical regions (A and B), each one characterized by the presence of two firms, one more productive than the other. Assume now that in region A, due to an exogenous shock unrelated to firms' productivity, inputs are reallocated from the less to the more productive firm, while nothing changes in B. As a result, the two regions start to diverge in terms of output, although no relative changes in factor endowments or trade/transport costs have taken place. The latter source of regional disparities is thus entirely endogenous to the heterogeneity of firms' behaviour in the considered regions. Focusing on one case study, namely the exogenous shock of transition from plan to market of a large Eastern European country, Romania, this

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article aims at providing an empirical assessment of such a potential source of regional disparities, exploring at the same time various dimensions of firm heterogeneity which might induce it.

The rise and persistence of income disparities across regions is also a major topic of discussion among policy makers. For example, the European Union is allocating a total of Euro 251 *billions* in the period 2007–2013 with the explicit aim of fostering income convergence across its regions.[1] However, no generalized consensus exists on the exact policy actions to be undertaken, since a precise assessment of the sources of these disparities is still lacking.

In the study of spatial inequalities, economic theory has traditionally focused on the role of factors' endowments and their accumulation. Standard neoclassical economic models suggest that, under diminishing returns and free movement of factors, per capita income levels within an economic area should converge over time to the same steady state value (Barro and Sala-i-Martin, 1991). Such a view has nevertheless been challenged since long by many authors (e.g. Durlauf and Johnson, 1995 or Quah, 1996, to quote the early contributions) which, using various econometric methods, have found a persistence of income disparities, therefore, arguing that the pattern of cross-country growth is more consistent with endogenous growth, rather than neoclassical theories. The works of Canova and Marcet (1995) and De la Fuente (2002), to mention just two of a large set of contributions, have confirmed by and large the persistence of income disparities also at the regional (within-country) level.

More recently, new economic geography (NEG) has introduced the role of market access and cumulative processes in the study of regional disparities (Krugman et al., 1999). NEG models postulate that, in the presence of positive trade costs and increasing returns to scale, demand can be endogenous to the market-access enjoyed by a given location. The latter effect might induce a cumulative causation process that, as integration proceeds, tends to open differences even between initially similar regions.[2] The importance of 'second-nature' geography (i.e. the distance between economic agents) in influencing cross-country income distribution and in shaping production structures across space has been confirmed in a number of empirical studies, surveyed by Overman et al. (2003).

Nevertheless, the exact channels and the extent to which 'first nature' (endowments and comparative advantages) versus NEG forces really matter in affecting income disparities is still subject of investigation. Moreover, while most studies have focused on aggregate variables or have treated individual firms symmetrically, firm heterogeneity might act as a third channel influencing this picture. As discussed in the previous example, in fact, diverse populations of firms in different regions might react very differently to a common shock, thus inducing the emergence of spatial disparities through a channel endogenously driven by firm heterogeneity. In this article, the latter channel of inequalities is explored for the case of Romania, a large country in Eastern Europe for which the full census of firms' data is available to us since 1996. Romania represents a very interesting case study for our purposes since, before the shock of transition from plan to market, the country experienced limited factor movements

1 European Commission (2006) *Fourth progress report on cohesion: Growth and jobs and the Reform of European cohesion policy*, COM(2006) 281 final, Brussels.

2 Puga (1999) actually shows that regional inequalities might rise and then fall as integration proceeds if factors are not perfectly mobile.

across its regions, associated to low regional disparities. After 1995, i.e. since when we have census data, disparities started to increase along the transition process, thus providing us with an ideal control for initial conditions.[3]

At the methodological level, we capitalize on some contributions that exploit the increasing availability of firm-level data and identify the connection between micro- and aggregate-productivity measures.[4] In particular, the starting point of analysis is the parallelism existing between the channels driving aggregate output growth as identified by the macroeconomic literature, and the channels that the previously quoted micro literature, starting from firm-level observations, has identified as sources of change in industry productivity. The macro literature points to technological diffusion (Keller, 2002) and reallocation of production factors (De la Fuente, 2002) as possible drivers of income disparities.[5] Similarly, the microeconometric approach has identified the following sources of changes in aggregate industry productivity: a within-plant component, deriving from plant-level changes in productivity (and hence related to technology diffusion), a between-plant component reflecting changes in the allocation of production factors, and the effect of entry and exit of firms.[6]

If firm-level data allow to retrieve regional output as the aggregation of individual firms' observations, the micro and macro approaches can be bridged. For instance, one could decompose output variations along the within, between and net entry channels, and then aggregate the various components within regions to recover a precise measure of the sources of aggregate income growth. A comparison of these components across regions would then yield a microfounded assessment of the channels that drive regional disparities.

Indeed, Rigby and Essletzbichler (2000) and, more recently, Böckerman and Maliranta (2007) have already started looking at the evolution of regional disparities from this perspective, decomposing, through firm-specific observations, an aggregate measure of regional productivity along the within, between and net entry channels. In particular, the latter authors find that long-lasting differences in productivity growth between Southern and Eastern Finland can be attributed to differences in the between and entry components of aggregate productivity dynamics.

However, the link between the evolution of an aggregate regional productivity index (then decomposed along the previous channels) and aggregate regional output is not

3 The EBRD Transition Index, whose conventional values go from 0 (planned economy) to 5 (market economy) reports a value for Romania of 2.4 in 1995, then steadily increasing above the mid-threshold of 2.5 in the following years.

4 The surveys of Foster et al. (2001) and Van Biesebrock (2003) discuss the relation between heterogeneous firm-level dynamics and aggregate industry productivity in different countries. Bartelsman et al. (2004), starting from firm-level observations on productivity, are able to provide detailed descriptive evidence on the various channels affecting growth across 24 countries and 2-digit industries over the past decade.

5 Among others, Boldrin and Canova (2001) show that most of the regional income differences in their EU sample of regions can be attributed to differences in total factor productivity (TFP) originating from technology diffusion rather than differences in per worker capital stocks. Kumar and Russell (2002) have employed non-parametric production-frontier techniques to decompose international macroeconomic convergence (measured as labour productivity growth across countries) into components related to technological catch-up, technological progress and capital deepening.

6 Among others Baily et al. (1992), Griliches and Regev (1995), Olley and Pakes (1996), Tybout and Liu (1996), Haltiwanger (1997).

straightforward. As noted by Levinsohn and Petrin (2003a), when constructing an aggregate productivity index from firm-level observations, the weights employed in the summation are such that no function of aggregate productivity can reproduce the dynamics of aggregate output. Moreover, since the productivity index has no clear unit of measurement, aggregations and comparisons across industries (e.g. within a region) are problematic. Because of these two shortfalls, the traditional methodology employed for aggregating and decomposing industry-level productivity is not fully suitable as a tool to explore the regional dynamics of output. The solution of the latter methodological problem and its application to the analysis of regional disparities are the main objectives of this article, and its contributions to the literature.

To cope with the aggregation issues, we follow Levinsohn and Petrin (2003a) and adapt to the regional case a decomposition of firm-level output and value added (rather then productivity) dynamics, always starting from semi-parametric, firm-specific productivity estimates. We then apply this methodology, to the analysis of regional dynamics in Romania, during the transition period, 1996–2001 Through our methodology, we are able to decompose, for each year, the aggregate country's output/value added dynamics across its regions and along the previously discussed channels of firm-level changes in productivity, input reallocation and net entry. Moreover, we are able to explore, within the same decomposition, the role played by domestic versus affiliates of foreign multinational enterprises (MNEs), as well as other dimensions of firm heterogeneity. The whole exercise would not be possible through traditional decompositions of productivity, due to a number of aggregation problems.

Based on this analysis, we are able to derive a microfounded explanation for the sources of aggregate growth and the rise and persistence of regional inequalities in Romania. In particular, our results show that the standard channels of firms and labour cross-regional reallocation determine the increase in inequalities only to a limited extent. Indeed, the largest driver of regional disparities is represented by the diverging restructuring performance of incumbent firms in different areas of the country. The latter is partly associated with an unfavourable sectoral specialization in the underperforming regions at the beginning of transition. Hence, consistently with the simple example provided above, disparities are partly endogenous to the interaction of firm-level dynamics and the initial distribution of economic activities. Such a result, linking firm heterogeneity to the emergence of regional disparities, goes along the same lines of research of Baldwin and Okubo (2006), who have started exploring the role of firm heterogeneity in a NEG theoretical framework.

At the end of the article we also investigate the presence of regional spillovers from affiliates of foreign MNEs to domestic firms, finding unbalanced effects across regions and thus providing a potential microfounded explanation for the eventual persistence of regional disparities after the end of transition.

The article is structured as follows. Section 2 introduces the methodological framework through which it is possible to nest firm-level productivity estimates within a regional dimension, recovering a microfounded decomposition of aggregate output/value added growth at the regional level. Section 3 discusses our dataset and presents the decomposition of the aggregate sources of growth in Romania, together with some robustness checks with respect to the firm-level estimation of TFP. Section 4 explores in detail the firm-level drivers of regional disparities, including possible spillovers arising from affiliates of foreign MNEs, while Section 5 concludes.

2. Methodological framework

Let ω_{jt} denote the aggregate TFP of a given industry j at a point in time t. The latter has been usually measured as the residual obtained by subtracting the predicted log output $\hat{y}_{jt}$ from the actual log output y_{jt} of the considered j-industry. In particular, $\hat{y}_{jt}$ has been in general calculated using log inputs x_{jt} within a Cobb-Douglas aggregate production technology characterized by a vector β of coefficients. Hence

$$\omega_{jt} = y_{jt} - \hat{y}_{jt} = y_{jt} - \beta' x_{jt} \tag{1}$$

As it is well known, a shortfall of this methodology is that it implies that any redistribution of inputs across plants results in the same aggregate output, which might not be the case if, for example, firms within the industry are hetereogeneous in productivity levels and more inputs flow to the most productive firms. Hence, the literature has started to employ firm-level TFP estimates of the form

$$\omega_{ijt} = y_{ijt} - \hat{y}_{ijt} = y_{ijt} - \beta' x_{ijt} \tag{2}$$

where the subindex denotes firm i. Industry-level TFP estimates are then obtained by aggregating firm-level measures through productivity indexes of the form $\Omega_{jt} = \sum_{i=1}^{N} s_{ijt}\omega_{ijt}$, where a measure Ω_{jt} of the industry-level TFP is obtained as a weighted average of the firm-specific productivity ω_{ijt}, using output or input shares s_{ijt} as weights.[7]

As noted by Levinsohn and Petrin (2003a), the construction of the index Ω_{jt} implies two shortfalls, which are crucial for our aggregation problem. First, due to the weights employed in the summation, no function of aggregate productivity Ω_{jt} can reproduce the dynamics of aggregate output y_{jt}.[8] Second, since Ω_{jt} is an index with no clear unit of measurement, aggregations and comparisons across industries (e.g. within a region) are problematic. Because of these two shortfalls, the traditional methodology employed for the aggregation of firm-level productivity cannot be used as a tool to explore the regional dynamics of output.

In order to solve these drawbacks, Levinsohn and Petrin (2003a) have proposed to aggregate firm-specific TFP measures using a different weighting system. This can be easily seen by reworking Equation (2) to obtain

$$Y_{jt} = \sum_{i=1}^{N} z_{ijt}\mathrm{TFP}_{ijt} \tag{3}$$

where Y_{jt} is the aggregate output (in levels) of our j-industry, $\mathrm{TFP}_{ijt} = e^{\omega_{ijt}}$ is the exponentiated measure of TFP and $z_{ijt} = e^{\beta' x_{ijt}}$ is what Levinsohn and Petrin (2003a) refer to as an input index. In doing so, every element in the sum has as units the original

7 Baily et al. (1992) were among the first to calculate in this way the aggregate productivity index using as weights the output shares of each firm. Foster et al. (2001) however argue that, being output dependent on productivity, it is better to use input shares as weights, hence $s_{it} = X_{it}/\sum_j X_{jt}$, where $X_{it} = e^{X_{it}}$. Van Biesebroeck (2003) warns that using inputs as weights nevertheless induces a lower productivity average, as plants that improve productivity most are those that use less inputs per unit of output and hence receive a low weight.

8 For example, the change in industry output while holding industry inputs constant cannot be recovered as the product of output mesured in $t-1$ times $\Delta\Omega_{jt}$. Similar critiques to the aggregation Ω_{jt} are also pointed out by Van Biesebroeck (2003).

unit in which output is measured, and hence aggregations and comparisons across industries become possible.

Moreover, denoting $\Delta Y_{jt} = \sum_{i=1}^{N} z_{ijt}\mathrm{TFP}_{ijt} - \sum_{i=1}^{N} z_{ijt-1}\mathrm{TFP}_{ijt-1}$ and manipulating this expression in order to take into account the entry and exit of firms, it is possible to decompose the changes in output of the *j*-industry, ΔY_{jt}, as

$$\begin{aligned}\Delta Y_{jt} = &\sum_{i\epsilon C}\left[z_{ijt-1}\Delta\mathrm{TFP}_{ijt} + \Delta z_{ijt}\mathrm{TFP}_{ijt-1} + \Delta z_{ijt}\Delta\mathrm{TFP}_{ijt}\right] \\ &+ \sum_{i\epsilon E} z_{ijt}\mathrm{TFP}_{ijt} - \sum_{i\epsilon X} z_{ijt-1}\mathrm{TFP}_{ijt-1}\end{aligned} \tag{4}$$

where the total number of plants N has been decomposed in three sets: those who continue their business over time (C), those who enter at a given time (E) and those who exit (X). The first term in square brakets measures the 'within' component, i.e. variations in aggregate output induced by changes in productivity, holding the inputs constant; the second term captures the 'between' component, i.e. the variation in the use of inputs, keeping productivity constant; the third term is the covariance between productivity growth and input changes.[9] The remaining addenda measure instead the effects of entry and exit on aggregate output growth. Equation (4) is very flexible, since essentially it decomposes the changes in aggregate output of industry *j* starting from firm-level data, thus allowing us to analyse the impact of different dimensions of firm heterogeneity.

In particular, since various studies (De Backer and Sleuwaegen, 2003) have shown that foreign MNEs might have different productivity, inputs and entry/exit dynamics than domestic firms, we further decompose Equation (4) to account for the effects of heterogeneity in ownership, separating domestic from foreign-owned multinational firms. This can be simply done by distinguishing the input indexes z_{it}^{M} and productivity TFP_{it}^{M} of multinationals from the ones of domestic firms, z_{it}^{D} and TFP_{it}^{D}, with M and D denoting the foreign or domestic ownership of each firm, respectively. Hence, it is possible to rewrite Equation (4) as

$$\begin{aligned}\Delta Y_{jt} = \sum_{H=M,D}\Bigg\{&\sum_{i\epsilon C}\left[z_{ijt-1}^{H}\Delta\mathrm{TFP}_{ijt}^{H} + \Delta z_{ijt}^{H}\mathrm{TFP}_{ijt-1}^{H} + \Delta z_{ijt}^{H}\Delta\mathrm{TFP}_{ijt}^{H}\right] \\ &+ \sum_{i\epsilon E} z_{ijt}^{H}\mathrm{TFP}_{ijt}^{H} - \sum_{i\epsilon X} z_{ijt-1}^{H}\mathrm{TFP}_{ijt-1}^{H}\Bigg\}\end{aligned} \tag{5}$$

Finally, exploiting the additivity property of our decomposition across industries, given a region r where M industries are operating, the changes in the regional aggregate output ΔY_t^r can be easily obtained as

$$\Delta Y_t^r = \sum_{j=1}^{M} \Delta Y_{jt}^r \tag{6}$$

9 Technically the z_{it} are not weights, since they do not sum to 1. Hence, Δz measures the extent to which a firm is increasing or decreasing its level of inputs, rather than the change in market share of the same firm. The present methodology is thus different from the decompositions of productivity indexes traditionally used by the literature (Haltiwanger, 1997; Griliches and Regev, 1995). We will further discuss our approach when fitting the decomposition to the dataset.

Equations (5) and (6) provide a microfoundation of the sources of regional output growth starting from the underlying firm-level dynamics. In particular, we are able to distinguish the role of net entry versus the dynamics of continuing firms in driving regional output (along the within, between and covariance channels), and the specific contribution of MNE's affiliates versus domestic firms. All these effects, in turn, allow us to precisely analyse the drivers of regional disparities.

3. Firm heterogeneity and growth decomposition

3.1. The Romanian data

The previously discussed decomposition has been applied to the case of Romania, a large transition country displaying significant diverging dynamics across the eight administrative regions making up its territory. In particular, Table 1 shows the per capita GDP of the Romanian regions as a percentage of the national average from 1995 to 2001, based on official statistics. As it can be seen, regions started to diverge since the beginning of transition in 1995: the standard deviation of regional per capita GDP (a measure of regional disparities known as σ-convergence) more than doubled in the considered period. In particular, five regions have started to lag behind, with an average index of per capita GDP dropping from 90% of the national average in 1995 to 0.79 in 2001; two regions (Vest and Centru) have displayed income dynamics above the national average, while the capital region, Bucuresti, clearly outperformed all the others.[10]

To analyse the microsources of these increasing disparities, we employ a dataset composed of domestic firms and affiliates of foreign MNEs operating for the period 1996–2001 in Romania, as retrieved from AMADEUS. The latter is a dataset provided by a consulting firm, Bureau van Dijck, containing balance sheet data in time series for a sample of roughly 7,000,000 companies operating in various European countries. In the case of Romania, the dataset covers the entire census of operating firms, since it reports the information recorded by the Romanian Chamber of Commerce and Industry, the institution to which all firms have to be legally registered and report their balance sheet data. Although we will refer to our observational units as firms, the data are actually unconsolidated to the plant level of disaggregation.[11] For every firm we have retrieved information on its location within each of the eight Romanian regions, the industry in which these firms operate (at the NACE-4 level), as well as yearly balance sheet data on tangible fixed assets, number of employees, material costs, value of production and value added.

Given the nature of the data, we have to address a number of methodological issues. First of all, the estimation of a production function in industries other than

10 The case of Romanian regions is in line with the dynamics experienced by other countries in the area. The Third Report on Economic and Social Cohesion of the European Commission (2004) reports in fact that growth in the countries of Central and Eastern Europe has been disproportionately concentrated in a few regions, particularly in capital cities and surrounding areas.

11 In the Amadeus data for Romania, each legal entity has its own balance sheet and each plant of an entity reports its own balance sheet. Since we are using only unconsolidated data, information in our dataset refers to one single plant at the time. For example, the German steel company 'Thyssenkrupp' reports in our dataset separate data for two plants in the same city (Sibiu), both active in the same 4-digit sector (nace 3430: manufacture of parts and accessories for motor vehicles and their engines).

Table 1. Regional disparities in Romania, 1995–2001 (regional per capita GDP, as a percentage of the national average)

	1995	1996	1997	1998	1999	2000	2001
RO01 Nord-Est	0.78	0.79	0.76	0.90	0.97	0.67	0.69
RO02 Sud-Est	0.96	0.99	0.99	0.90	0.86	0.85	0.82
RO03 Sud	0.93	0.90	0.88	0.81	0.78	0.79	0.76
RO04 Sud-Vest	0.94	0.88	0.92	0.87	0.85	0.81	0.81
RO05 Vest	1.06	1.04	1.10	1.08	1.07	0.99	1.02
RO06 Nord-Vest	0.92	0.91	0.90	0.88	0.87	0.89	0.89
RO07 Centru	1.05	1.10	1.09	1.02	0.99	1.02	1.00
RO08 Bucuresti	1.34	1.38	1.37	1.54	1.61	1.98	2.02
σ-convergence	*0.16*	*0.18*	*0.19*	*0.23*	*0.26*	*0.41*	*0.43*

Source: Authors' elaboration on Eurostat data (REGIO dataset).
σ-convergence is measured as the standard deviation of the regional indexes.

manufacturing and construction is not straightforward, potentially generating biases that we want to exclude in the analysis. Second, the panel data retrieved from AMADEUS is unbalanced, i.e. it incorporates firms' entry and exit, which have to be properly controlled for. Third, information on the ownership structure is not available for all firms.

In order to cope with the first of these issues, we have concentrated our analysis on the manufacturing and construction industries only. Restricting our observations to these industries, we still recover a picture of increasing regional disparities. In particular, as discussed in Annexe 1, regional disparities calculated on official data for manufacturing and construction are correlated 0.89 with the official figures for the entire economy reported in Table 1. Moreover, even in this case the two regions of Vest (RO05) and Centru (RO07), together with Bucuresti (RO08), display a performance above the country average (see Table A1.2 in Annexe 1). For the purpose of our analysis, the latter finding allows us to partition the Romanian regions in two groups: the three regions performing above the country average (Vest, Centru and Bucuresti), which we will refer to as the 'Top 3' regions, and the others.

The second issue arising from our data is related to the treatment of firms' entry and exit. To this extent, the year in which the first observation is recorded denotes a firm's entry, while exit is assumed to take place in the year after which no new information is available in the dataset.[12] Third, we have included in the sample only those firms for which information on the ownership structure is available: in particular, according to the standard IMF definition, a firm is considered as foreign MNE affiliate if more than 10 per cent of its capital is foreign owned, and domestic otherwise.[13] Clearly, given the nature of our data, it could be the case that a firm exits and then reappers under a new name, eventually due to a change in ownership: a detailed discussion of all these

12 For example, a firm whose first observation is recorded in 1997 and last observation is recorded in 2000 is considered active from 1997 to 2000, even if data for 1998 or 1999 are missing. See Annexe 1 for further details.

13 The implications of a varying degree of foreign ownership in MNEs' affiliates for Romania are discussed by Spatareanu and Smarzynska Javorcik (2008).

methodological issues, together with a detailed validation of the dataset, is presented in Annexe 1, while in the remaining of the article we will integrate our results with some robustness checks with respect to these issues.

The dataset retrieved from the Romanian census is analysed in Table 2, and consists of 39,799 active firms at the beginning of the period (of which 36,634 are domestically owned and 3165 display a multinational participation), then becoming 48,718 in 2001 (of which 41,981 domestic and 6737 MNEs). These figures correspond to 95% of all official firms operating in Romania in manufacturing and construction, with the exception of 2001, where this percentage drops to 85%. Entry rates tend to overcome the exit of firms at the beginning of the period, while exit rates grow larger towards the end, a pattern not surprising for a transition country, where soft budget constraints are progressively removed. Moreover, the share of MNEs increases from 8% to 14% of the total. Finally, for both the domestic and multinational firms, the food (NACE-15) and construction (NACE-45) industries are the two largest in terms of number of entities over the considered time span.

In terms of validation, the sample coverage is lower if we consider only those firms for which information is available for all the variables of interest in the calculus of TFP, as reported in Annexe 1.[14] Nevertheless, even the latter restricted sample, covering around 50% of all official firms, is unbiased with respect to our research objective. In fact, aggregating each firm's value added in each region as a proxy of regional GDP, the resulting correlation between the per capita regional value added as retrieved from our restricted sample and the official figures of Table 1 is 0.87 (see Annexe 1 for a detailed discussion). Hence our dataset, even when cleaned for missing observations on all the variables of interest taken jointly, is in any case able to reproduce the dynamics of regional disparities in Romania.

3.2. Production function estimation and decomposition of growth

As already discussed, the first step of our methodology relies on a correct estimation of individual firms' TFP. To calculate firm-specific productivity, we have first assigned our observational units to the NACE2 industries reported in Table 2, and then we have applied the Levinsohn and Petrin (2003b) semi-parametric estimation technique to each industry.[15] This has allowed us to solve the simultaneity bias affecting standard estimates of firm-level productivity, as well as to derive TFP estimates from heterogeneous, industry-specific production functions (see Annexe 2 for further details).[16] Furthermore, to account for heterogeneity in firms' ownership,

14 For example, while the time series of turnover tend to be complete for every active firm, the data on employment present more missing observations.

15 The tobacco and fuel industries (NACE16 and 23) have displayed insufficient variation to identify the input coefficients. Moreover, we have excluded the recycling industry (NACE37) as well, since in the latter case the estimation of a production function is, again, not straightforward. Accordingly, these industries have been eliminated altogether in all the reported Tables.

16 Using ordinary least squares when estimating productivity implies treating labour and other inputs as exogenous variables. However, profit-maximizing firms adjust their inputs each time they observe a productivity shock, which makes input levels correlated with the same shocks. Since the latter are unobserved to the econometrician, inputs turn out to be correlated with the error, biasing the OLS estimates of production functions. Olley and Pakes (1996) and Levinsohn and Petrin (2003b) have developed two similar semi-parametric estimation procedures to overcome this problem, using investment and material costs, respectively, as proxies for these unobservable shocks.

Table 2. The census of Romanian firms in manufacturing and construction (1996–2001, number of firms and rates)

Year	Sample stock (AMADEUS)	Official stock	Sample coverage
1996	39,799	41,228	0.97
1997	43,593	45,432	0.96
1998	47,491	49,324	0.96
1999	50,257	52,295	0.96
2000	50,246	53,568	0.94
2001	48,718	57,086	0.85

of which:

	Domestic firms			Multinational firms					
Year	Entry	Exit	Active firms	Entry	Exit	Active firms	MNEs penetration	Entry rate	Exit rate
1996			36,634			3165	0.08		
1997	4771	1576	39,829	728	129	3764	0.09	0.14	0.04
1998	5006	1827	43,008	880	161	4483	0.09	0.14	0.05
1999	4606	2685	44,929	1048	203	5328	0.11	0.12	0.06
2000	2514	3422	44,021	1212	315	6225	0.12	0.07	0.07
2001	2228	4268	41,981	1234	722	6737	0.14	0.07	0.10

Percentage of industry distribution over total sample:

		1996			2001		
Description	NACE 2	All firms (%)	Dom (%)	MNEs (%)	All firms (%)	Dom (%)	MNEs (%)
Food products and beverages	15	25.5	25.4	27.7	22.5	22.9	19.8
Textiles	17	4.4	4.4	4.4	3.9	3.8	5.1
Wearing apparel; dressing and dyeing of fur	18	8.0	8.2	6.5	7.7	7.5	9.4
Leather and leather products	19	2.3	2.2	3.8	2.6	2.1	5.6
Wood and wood products	20	7.9	7.9	7.6	8.4	8.1	10.4
Pulp, paper and paper products	21	1.0	0.9	1.9	1.0	0.9	1.7
Publishing, printing and reproduction of recorded media	22	5.2	5.1	6.5	5.4	5.5	4.7
Chemicals, chemical products and man-made fibres	24	2.0	1.9	3.5	2.1	1.9	3.1
Rubber and plastic products	25	3.1	2.9	4.4	3.0	2.7	4.5
Other non-metallic mineral products	26	2.6	2.6	2.8	2.7	2.7	3.1
Basic metals	27	0.7	0.7	1.2	0.8	0.7	1.2
Fabricated metal products, except machinery/equipment	28	5.7	5.9	4.5	6.0	6.1	5.3
Machinery and equipment n.e.c.	29	1.5	1.4	3.0	1.7	1.5	3.1
Office machinery and computers	30	0.8	0.7	2.1	0.9	0.8	1.2
Electrical machinery and apparatus n.e.c.	31	1.1	1.1	1.7	1.2	1.0	1.8
Radio, television and communication equipment/apparatus	32	0.3	0.3	0.9	0.3	0.3	0.7
Medical, precision and optical instruments, watches/clocks	33	1.0	1.0	1.3	1.0	1.1	0.9
Motor vehicles, trailers and semi-trailers	34	0.5	0.5	0.9	0.6	0.5	0.9
Other transport equipment	35	0.4	0.4	0.5	0.5	0.4	0.7
Furniture; manufacturing n.e.c.	36	5.1	5.1	5.2	5.3	5.2	5.8
Construction	45	20.7	21.7	9.7	22.3	24.1	11.0
	Total firms	39,799	36,634	3165	48,718	41,981	6737

Source: Author's elaboration from Amadeus data.

possibly leading to different productivity dynamics between foreign MNEs' affiliates and domestic firms (De Backer and Sleuwaegen, 2003), we have always run separately the production function estimations for domestic and multinational firms within the same industry.

More specifically, following standard practice in the literature, output is proxied in the estimations by turnover (i.e. value of production), deflated using NACE2 industry-specific price indices retrieved from the Eurostat New Cronos and the Vienna Institute of International Economics (WIIW) databases. Material costs in each industry are deflated by a weighted average of the producer price indices of the supplying sectors, with weights extracted from the Romanian input–output matrix (1998 release) and representing the proportion of inputs sourced from any given sector. The labour input is measured by the number of employees, while capital is proxied by the value of tangible fixed assets deflated using the GDP deflator. In order to check the appropriateness of our correction for simultaneity, Table 3 shows, for both domestic and multinational firms, the typical upward bias in the labour coefficient that emerges when confronting the results of the semi-parametric estimates of productivity with standard OLS results.[17]

In Table 4, we exploit the productivity estimates so obtained for calculating the decomposition of changes in national output (ΔY_t) by aggregating Equation (5) across all industries, thus ignoring for the time being the regional dimension. More specifically, we have aggregated all our (deflated) firm-specific observations on turnover and then we have calculated the yearly changes in national output ΔY_t (measured in thousands of real euros), reporting them in Column 2 of Table 4 (upper panel). First of all, note that the reported changes in national output are always negative for the considered period, but they tend to become smaller over the years. This pattern is entirely consistent with the transition experience of Romania: from 1995 onwards, official measures of Romania's GDP tend to display a U-shaped evolution over time. The latter confirms the previously discussed high correlation of our firm-level information with official data.

Adopting the Levinsohn and Petrin (2003a) methodology for aggregating firm-level observations, the same figure of output growth can be precisely retrieved as the sum of the four elements in which we can decompose ΔY_t [i.e. summing the figures under the 'all firms' headings of Table 4 (upper panel)], thus deriving important information on the sources of output dynamics. As it can be seen, each of the four elements can also be further decomposed to disentangle the contribution of domestic versus foreign MNEs.

In order to better discuss the results, in Table 4 (lower panel) we have expressed the figures displayed in Table 4 (upper panel) in percentage terms, with the sum of the 'all firms' headings of the decomposition yielding −100% (i.e. a positive variation represents a positive contribution to output changes, reported in the first column).[18] Limiting for the time being our attention to the 'all firms' headings, it can be seen

17 Olley and Pakes (1996) and Levinsohn and Petrin (2003b) also discuss in their estimates the possible selection bias arising from the exit of firms, possibly leading to an underestimation of the capital coefficients in the production function. However, both papers do not find significant changes when correcting for exit. In our case, we have re-estimated all the industry specific production functions both on the balanced and unbalanced samples, finding no significant differences in the coefficients.

18 For example, Table 4 (lower panel) shows that in 1997 MNEs, via the channel of productivity changes, have contributed positively for 3% of total output changes (−2150, 499) in Romania: this corresponds to the figure of 63,358 (thousands of real euros) reported in Table 4 (upper panel).

Table 3. A comparison of productivity estimates for some selected industries

	NACE	(15)	(19)	(20)	(22)	(24)	(26)	(36)
Domestic								
Lev Pet (2003)	ln (labour)	0.027***	0.273***	0.085***	0.179***	0.071***	0.123***	0.117***
	ln (materials)	0.982***	0.968***	0.723***	0.362*	0.742***	0.674***	0.640***
	ln (capital)	0.074**	0.088***	0.189***	0.340***	0.147***	0.177***	0.208***
OLS	ln (labour)	0.133***	0.427***	0.301***	0.542***	0.267***	0.355***	0.355***
	ln (materials)	0.927***	0.716***	0.867***	0.761***	0.953***	0.820***	0.805***
	ln (capital)	0.033***	0.063***	0.026***	0.006	−0.050***	−0.006	0.003
	OLS bias in labour coeff.	+	+	+	+	+	+	+
	OLS bias in capital coeff.	–	–	–	Not sign.	–	Not sign.	Not sign.
	No. of obs.	38,301	3347	13,000	8948	3449	4419	8184
MNEs								
Lev Pet (2003)	ln (labour)	0.045***	0.329***	0.079***	0.312***	0.056***	0.201***	0.183***
	ln (materials)	0.939***	0.649***	0.870***	0.893**	0.926***	0.907***	0.864***
	ln (capital)	0.081**	0.143***	0.044	0.069**	0.109***	0.091**	0.075***
OLS	ln (labour)	0.123***	0.508***	0.253***	0.613***	0.238***	0.372***	0.354***
	ln (materials)	0.928***	0.588***	0.870***	0.682***	0.933***	0.804***	0.794***
	ln (capital)	0.045***	0.113***	0.017***	0.005	−0.015	−0.025**	0.017*
	OLS bias in labour coeff.	+	+	+	+	+	+	+
	OLS bias in capital coeff.	–	–	Not sign.	Not sign.	Not sign.	–	–
	No. of obs.	6273	1535	2568	1529	1030	862	1632

See Table 2 for a description of the NACE sectors. ***, ** and * significant at the 1, 5 and 10% level.

that the negative changes in output are largely driven by the between component ($\Delta z_{it}\text{TFP}_{it-1}$), i.e. by the fact that incumbent firms in Romania are decreasing their absolute level of input usage as a reaction to the transition from plan to market. Changes in output pertaining to productivity dynamics (the within component z_{it-1} ΔTFP_{it}) are also negative, but are smaller in magnitude. The intuition that a restructuring process is ongoing in the country is also confirmed by the negative sign of the covariance term ($\Delta\text{TFP}_{it}\Delta z_{it}$), indicating that the downsizing of inputs is correlated with positive productivity changes. Finally, net entry tends to positively contribute to the dynamics of output: in particular, our figures (not reported in Tables) indicate that gross entry is larger than exit by a factor of 2.7, on average, in line with the existence of soft budget constraints operating in the early stages of the transition process.

As already mentioned, one important additional feature of our decomposition is the possibility to control for firm heterogeneity, disentangling the contributions to the evolution of aggregate output separately for domestic firms and affiliates of foreign enterprises. The results reported in Table 4 show that MNEs' affiliates tend to outperform domestic firms in terms of productivity changes (the within component $z_{it-1}\Delta\text{TFP}_{it}$). Moreover, the process of shedding inputs (the between component $\Delta z_{it}\text{TFP}_{it-1}$) tends to end sooner for MNEs than for domestic firms. The larger negative size of the covariance term ($\Delta z_{it}\Delta\text{TFP}_{it}$) also suggests that, throughout the entire time span, the downsizing process in the case of MNEs tends to be more

Table 4. Decomposition of output—yearly changes, all regions

	ΔY_t	Within ($z_{t-1} * \Delta TFP_t$)			Between ($TFP_{t-1} * \Delta z_t$)			Covariance ($\Delta TFP_t * \Delta z_t$)			Net entry		
All regions	All firms	Dom	MNEs	All firms	Dom	MNEs	All firms	Dom	MNEs	All firms	Dom	MNEs	All firms
Upper panel: '000 of real €, Levinsohn-Petrin (2003a) TFP estimates in gross output													
1997	−2,150,499	−63,494	63,358	−136	−1,129,921	−1,047,625	−2,177,546	10,819	−66,933	−56,114	34,796	48,500	83,296
1998	−353,142	−13,660	6442	−7218	−194,574	−204,466	−399,040	−15,119	−23,126	−38,245	36,531	54,829	91,360
1999	−397,785	−30,299	18,182	−12,117	−201,897	−218,413	−420,310	−7764	−24,250	−32,013	19,827	46,828	66,655
2000	−226,356	−34,508	−3838	−38,345	−110,937	−96,657	−207,594	−1271	−15,117	−16,388	13,291	22,680	35,970
2001	−73,052	−7722	−104	−7826	−35,242	−5120	−40,362	−10,899	−16,126	−27,025	2531	−371	2160
Lower panel: Percentages, Levinsohn-Petrin (2003a) TFP estimates in gross output													
1997	−2,150,499	−0.03	0.03	0.00	−0.53	−0.49	−1.01	0.01	−0.03	−0.03	0.02	0.02	0.04
1998	−353,142	−0.04	0.02	−0.02	−0.55	−0.58	−1.13	−0.04	−0.07	−0.11	0.10	0.16	0.26
1999	−397,785	−0.08	0.05	−0.03	−0.51	−0.55	−1.06	−0.02	−0.06	−0.08	0.05	0.12	0.17
2000	−226,356	−0.15	−0.02	−0.17	−0.49	−0.43	−0.92	−0.01	−0.07	−0.07	0.06	0.10	0.16
2001	−73,052	−0.11	0.00	−0.11	−0.48	−0.07	−0.55	−0.15	−0.22	−0.37	0.03	−0.01	0.03

correlated with productivity gains than for domestic firms.[19] Finally, also in terms of net entry MNEs contribute to a larger extent to the output dynamics.

Quite reassuringly, all the results above are consistent with the general experience of transition, as well as with the most recent studies, which have applied productivity decompositions to transition countries.[20] We take the latter as a further indication that our methodology, decomposing output rather than productivity starting from firm-level observations, allows us to microfound the underlying sources of aggregate output dynamics.

Before moving on with the analysis of the sources of regional disparities, it is nevertheless important to assess the robustness of our results with respect to the estimation of TFP.

A first concern is related to the omitted price variable bias. Given the nature of our data, we have followed the standard approach of proxying physical output with deflated turnover, using industry-specific price deflators. Klette and Griliches (1996) however, argue, that such a procedure might lead to inconsistent estimates due to the correlation between firms' prices and their used inputs. As a result, they propose to control in the estimation of the production function for the degree of imperfect competition on the demand side of the market.[21]

We assess this critique in two ways: first of all, as already argued, we estimate different production functions for domestic and multinational firms, thus implicitly allowing for differentiated mark-ups among the two categories of firms. In addition, we allow for spatial substitutability in demand (Syverson, 2004) through a slightly modified version of the original Levinsohn and Petrin (2003b) algorithm, i.e. estimating separately for domestic and multinational firms an industry-specific production function augmented with regional fixed-effects.[22] The decomposition calculated using the latter productivity measures does not show, however, evidence of significant differences in the overall dynamics with respect to the decomposition previously discussed, which employs TFP measures retrieved from semi-parametric production function estimations considered only in their inter-industry variation.

As a further check, we have used simple OLS estimates of TFP and labour productivity.[23] The decomposition calculated using OLS measures of TFP reported a

19 Although we do not have information on the foreign firms' type of investment (i.e. greenfield versus brownfield FDI), the scale and restructuring intensity of these MNEs are suggestive of a prevalent brownfield modality of FDI. The latter is not surprising given the large participation of foreign investors in the privatization process of the mid-90s.

20 In particular, in their cross-country comparison, Bartelsman et al. (2004) find that the within-firm (productivity) component plays a lesser role in explaining productivity growth in transition countries, while De Loecker and Konings (2006) find, in the case of Slovenia (another transition country), that a substantial positive contribution in terms of job creation and growth comes from the net entry of new (mainly multinational) firms.

21 The latter entails an estimation of production function coefficients, which incorporate the (constant) term $\eta + 1/\eta$, where η is the elasticity of substitution between products. See De Loecker (2007) for a comprehensive treatment of this problem.

22 Note that, when running the original Levinsohn and Petrin (2003b) semi-parametric technique for all firms belonging to a given industry across regions, the intercept β_0 of the production function is not separately identified in the estimation (Annexe 2). In our modified procedure, instead, the regional fixed-effects are specifically observable in our measure of predicted output. As a result, we can retrieve firm-specific TFP measures corrected for region-specific effects.

23 We cannot implement in our sample the Olley and Pakes (1996) algorithm of TFP estimation, since the latter technique uses investment rather than material costs as a proxy for the unobservable shocks, and (due to an invertibility condition) can consider only firms reporting non-zero investments. Now, for most

different order of magnitude for the various addenda but delivered the same messages in terms of sign and evolution over time of each component (all these results are available on request). We did not calculate a decomposition using labour productivity, since the latter would imply a different interpretation of the addenda in the decomposition due to the different weights; nevertheless, labour productivity measures turned out to be correlated 0.7 with our retrieved semi-parametric TFP estimates, thus confirming the overall robustness of our methodology.

A more important concern of our analysis is instead related to the assumptions underlying the employed Cobb-Douglas functional form, which assumes an elasticity of substitution equal to -1 for the three inputs of labour, capital and materials. Indeed, the latter could be a quite restrictive assumption for some industries, where there is only a limited scope for substitution between materials and the other inputs (e.g. energy-intensive industries).[24] As a result, we have estimated TFP through the alternative version of the Levinsohn and Petrin (2003b) algorithm, which uses value added as the dependent variable. Such a methodology imposes the coefficient of material costs $\beta_m = 1$ across all industries, a quite restrictive assumption as well, but it does not impose the substitutability between materials, on the one hand, and capital and labour on the other. Moreover, decomposing aggregate value added rather than gross output changes avoids double-counting problems and is more consistent with the microfoundation of the official GDP measures, on which regional disparities are calculated.

The results of the decomposition in value added are presented in Table 5 (both in absolute terms and percentages) and are consistent with the output-based ones in terms of overall evolution of growth and the role played by the various channels. The only difference emerges with respect to the role of the between component, which loses importance in favour of the within component. This is consistent with the fact that materials normally get a high weight in the estimated production functions reported in Table 3. Moreover, capital and labour are more rigid factors than materials, another element that reduces the importance of the between term in the decomposition.

Given the discussion above, the value added decomposition will constitute our benchmark specification in the analysis of regional disparities carried out in the remaining of the article.

3.3. The role of firm heterogeneity

A major advantage of our decomposition is that every element in the sum has as units the original unit in which value added is measured (real euros), and hence it is possible to recover the exact dynamics of growth through proper aggregations of the decomposed elements across industries and regions. As stated by Levinsohn and Petrin (2003a), an important caveat is however related to the fact that the decomposition uses as weights the input index z_{it} and the productivity levels, whose terms do not sum up to one. As a result, rather than smoothing each individual

transition countries (and Romania is no exception), any proxy of investment is likely to contain a large number of zeros or negative values, due to the substantial restructuring of the capital stock that had to be undertaken in the early years of the transition process (in our sample the percentage of firms reporting zero or negative investments is around 70%). Thus, the use of the Olley and Pakes (1996) technique would introduce a significant selection bias in the analysis.

24 We are grateful to an anonymous referee for having pointed out this criticism.

Table 5. Decomposition of value added—yearly changes, all regions

	ΔVA_t	Within ($z_{t-1} * \Delta TFP_t$)			Between ($TFP_{t-1} * \Delta z_t$)			Covariance ($\Delta TFP_t * \Delta z_t$)			Net entry		
All regions	All firms	Dom	MNEs	All firms	Dom	MNEs	All firms	Dom	MNEs	All firms	Dom	MNEs	All firms
Upper panel: '000 of real €, Levinsohn-Petrin (2003a) TFP estimates in value added													
1997	−911,140	−285,979	−171,073	−457,052	−307,506	−308,513	−616,019	86,052	46,785	132,837	5097	23,998	29,095
1998	−146,904	−56,521	−50,682	−107,203	−20,996	−32,717	−53,714	−12,881	−6560	−19,441	12,695	20,758	33,453
1999	−155,770	−60,756	−42,352	−103,108	−29,367	−26,504	−55,871	−4015	−6862	−10,876	272	13,812	14,084
2000	−100,475	−46,533	−31,105	−77,637	−11,706	−8114	−19,820	−4255	−8396	−12,650	847	8785	9633
2001	−21,474	−13,864	2287	−11,577	6091	4651	10,742	−8953	−14,468	−23,421	2252	530	2782
Lower panel: Percentages, Levinsohn-Petrin (2003a) TFP estimates in value added													
1997	−911,140	−0.31	−0.19	−0.50	−0.34	−0.34	−0.68	0.09	0.05	0.15	0.01	0.03	0.03
1998	−146,904	−0.38	−0.35	−0.73	−0.14	−0.22	−0.37	−0.09	−0.04	−0.13	0.09	0.14	0.23
1999	−155,770	−0.39	−0.27	−0.66	−0.19	−0.17	−0.36	−0.03	−0.04	−0.07	0.00	0.09	0.09
2000	−100,475	−0.46	−0.31	−0.77	−0.12	−0.08	−0.20	−0.04	−0.08	−0.13	0.01	0.09	0.10
2001	−21,474	−0.65	0.11	−0.54	0.28	0.22	0.50	−0.42	−0.67	−1.09	0.10	0.02	0.13

observation within a weighted average, the decomposition becomes sensitive to missing observations and individual firms' size and productivity levels.[25]

The first concern is dealt with easily since, as already discussed, our dataset, even when cleaned for missing observations in all the variables of interest, is able to reproduce the actual evolution of regional value added in the country. To address the second issue, we have disentangled the within and between components across different firms' size and productivity categories, for both the balanced (firms active throughout the entire time span) and unbalanced sample. In fact, the sample of 'continuing' firms in our decomposition changes every year, due to net entry: therefore, it is possible that our restructuring dynamics are driven by changes in the sample composition rather than in firms' behaviour. The latter control also allows us to verify the robustness of our results with respect to a potentially imperfect measure of firms' exit that might affect the dataset, as already discussed.

The results of the analysis reported in Table 6 show that, on average over the considered period, the productivity performance (yearly percentage change in TFP) improves monotonically with initial firm size. In particular, smaller firms (in terms of average input index z_{it-1}) tend to display larger negative changes in productivity. Moreover, firms which are initially more productive (larger average TFP_{it-1}) tend to reduce less their input usage when controlling for the scale effect (i.e. calculating $\Delta z_t/z_{t-1}$), with even positive changes in inputs experienced by firms with larger initial values of TFP. Finally, in non-reported results, affiliates of foreign multinationals are found to outperform domestic firms, within each size category, in terms of productivity changes.[26] All these results hold for both the balanced and unbalanced samples.

We can, therefore, draw a first general conclusion from the analysis of the decomposition: at the national level, most of the U-shaped variations of value added in Romania are generated by the restructuring process of incumbent firms (both in terms of the within and between components), with net entry dynamics playing a significant, but smaller role. Firm heterogeneity with respect to ownership, initial size and productivity levels is relevant in this process. These conclusions are robust to changes in the sample induced by entry and exit of firms.

We are now ready to explore the drivers of territorial disparities, decomposing the national results across the Romanian regions.

4. Towards a microfoundation of regional disparities

Based on the evidence discussed insofar, the increase in regional disparities observed in Romania can be attributed to a number of explanations, not mutually exclusive. On the one hand, regional divergences could have arisen due to the standard drivers of economic geography: once factors were free to move after the beginning of the

25 The figures reported in our decomposition are the sum of individual firms' changes, and thus do not allow us to understand immediately whether larger or more productive firms behave differently with respect to their counterparts.

26 The better performance of MNEs' affiliates with respect to domestic firms is a common finding in the transition literature, for a variety of reasons: from the superior technology transferred by multinationals to a selection effect. For the goal of this article, we are however interested in distinguishing domestic and multinational ownership only as a possible dimension of heterogeneity associated to different restructuring dynamics, without exploring further any causal link.

Table 6. Analysis of firm level heterogeneity as of Table 5

	Within component		Between component	
	Avg. z_{t-1}	Avg. $\Delta TFP_t/TFP_{t-1}$	Avg. TFP_{t-1}	Avg. $\Delta z_t/z_{t-1}$
Unbalanced sample				
I	1.80	−0.31	0.54	−0.12
II	6.95	−0.24	1.45	−0.07
III	20.29	−0.23	2.84	−0.04
IV	69.88	−0.19	4.87	0.01
V	178.72	−0.17	6.89	0.04
VI	840.81	−0.10	8.92	0.05
Balanced sample				
I	2.30	−0.28	0.62	−0.13
II	7.00	−0.25	1.47	−0.09
III	20.52	−0.24	2.86	−0.07
IV	70.24	−0.21	4.90	−0.03
V	178.51	−0.16	6.88	−0.02
VI	850.87	−0.10	8.92	0.01

The 'within component' captures the effect of changes in productivity within firms, while holding the level of inputs fixed ($z_{t-1} * \Delta TFP_t$). The 'between component' reflects instead changes in employed inputs, holding fixed the productivity level ($TFP_{t-1} * \Delta z_t$).
I $= z_{t-1} < 5$ or $TFP_{t-1} < 1$; II $= 5 < z_{t-1} < 10$ or $1 < TFP_{t-1} < 2$; III $= 10 < z_{t-1} < 50$ or $2 < TFP_{t-1} < 4$; IV $= 50 < z_{t-1} < 100$ or $4 < TFP_{t-1} < 6$; V $= 100 < z_{t-1} < 500$ or $6 < TFP_{t-1} < 8$; VI $= z_{t-1} > 500$ or $TFP_{t-1} > 8$.

transition process, some regions might have started to attract a higher number of firms and/or workers, due to either better endowments and/or proximity to the EU borders (Resmini, 2007). A NEG-type mechanism of cumulative causation might have then exacerbated these effects. On the other hand, however, we have found *prima facie* evidence that regional disparities might be partly endogenous to the observed heterogeneity of firms: once free from the requirements of the planned economy, incumbent firms across regions might have started to respond differently, in terms of restructuring dynamics, to the changing market conditions.[27]

To shed further light on these issues, we have divided the eight regions in two groups: 'Top3' versus 'others', consistently with the evolution of regional disparities previously discussed. We have then performed a number of analyses on the various potential drivers of inequalities.

First of all, we have measured the evolution of total employment across regions. While at the beginning of our time span Top3 regions accounted for 37% of total employment, this share grew up to 41% in 2001. Such an increase is in line with the expected correlation between labour mobility and growth differentials. However, given its relatively small magnitude, such a channel can hardly be considered as the only factor responsible for the observed large increase in disparities. The latter result is confirmed when analysing the spatial distribution of each NACE2 sector and its evolution over time on the basis of the employment figures. In particular, for each single

27 The idea of institutional changes affecting the dynamics of firms' restructuring has been explored by Eslava et al. (2004) in the case of Colombia.

industry we have computed the employment-based Ellison and Glaeser (EG) index of geographic concentration (Ellison and Glaeser, 1999), using the eight Romanian regions as relevant spatial units.[28] Results in Table 7 show that half of the sectors are spatially concentrated at conventional levels (EG Index ≥ 0.02), with some of them very concentrated (EG Index > 0.05).

As it can be seen from the same Table 7, the ranking of sectors and index values tend to remain the same over the time span, thus providing evidence that the cross-regional distribution of industries, based on the employment figures, has remained relatively stable over time. This conclusion is confirmed when looking at the evolution of regional shares in the total employment of each sector, which are indeed almost constant over the time span.[29]

These results seem, therefore, to exclude that the emergence of regional disparities in the country is due to labour mobility or a change in industrial specialization entailed by that. Therefore, we have turned our attention to the analysis of other possible sources of inequalities, exploiting our methodology. In particular, in Table 8 we have recalculated the value added decomposition discussed in Table 5 separately for the two groups of regions (Top3 versus others). The first clearly visible difference between the two regional groups is related to the net entry component, whose positive contribution to value added growth is relatively higher in the Top3 regions, with the difference mostly driven by the net entry of foreign MNEs.[30] A first source of regional disparities in Romania might thus be reconducted to standard economic geography drivers: at the start of transition, some regions are better endowed with factors more attractive for MNEs, which start to invest as soon as barriers to the international mobility of capital are removed. The process might then be accelerated by a NEG-type mechanism of cumulative causation, through which the initial entry of firms in a given region endogenously boosts local demand, fostering the arrival of other firms and thus a magnification of the initial regional disparities.

However, the crucial point is that such a relatively standard explanation for the emergence of regional disparities is supported by our data only to a limited extent. Indeed, results in Table 8 show that net entry certainly differs across the two regional groups, but it is not driving the bulk of variations of value added within regions. Rather, in both regional groups the largest source of variation is given by the restructuring activity (changes in productivity and in input usage) undertaken by continuing firms, in line with the hypothesis put forward at the beginning of our article.[31]

28 The Ellison and Glaeser (1999) index is similar in interpretation to a Gini coefficient, but corrects for the concentration of the economic activity via the Herfindahl index. Thus, it is conceptually equal to the spatial Gini when the industry has many plants, but differs from the spatial Gini when there are few plants. Positive values denote an 'excess' of spatial concentration relative to a random allocation of plants across locations. See Ellison and Glaeser (1999) for a detailed discussion.

29 The small contribution of labour mobility is consistent with the established finding that gross migration flows tend to be pro-cyclical, while in Romania the transition to the market economy entailed a relatively long-lasting depression of economic activity.

30 In our sample, the positive net contribution of new MNEs explains on average 20% of variation in the value-added of the Top3 regions versus 5% for the remaining Romanian regions in the considered period. Moreover, the gross entry of MNEs is 77% larger in the Top3 regions versus the others over the considered period.

31 In a previous version of the paper, we have performed our regional analysis using a gross output, rather than value added, production function. The results, available on request, do not change. Also, as a

Table 7. EG index of concentration, by NACE2—1996 and 2001

Year	NACE2	EG Index	Year	NACE2	EG Index
1996	21	−0.08	2001	21	−0.01
1996	25	−0.04	2001	26	−0.01
1996	29	−0.02	2001	27	0.00
1996	27	−0.01	2001	25	0.00
1996	28	0.00	2001	15	0.00
1996	17	0.00	2001	28	0.00
1996	15	0.00	2001	45	0.00
1996	26	0.00	2001	17	0.01
1996	45	0.00	2001	18	0.01
1996	18	0.01	2001	33	0.01
1996	22	0.02	2001	29	0.01
1996	33	0.02	2001	24	0.02
1996	20	0.02	2001	36	0.02
1996	24	0.03	2001	31	0.02
1996	19	0.05	2001	20	0.03
1996	34	0.06	2001	22	0.04
1996	31	0.06	2001	19	0.08
1996	36	0.07	2001	30	0.17
1996	30	0.18	2001	35	0.21
1996	35	0.21	2001	34	0.22
1996	32	0.47	2001	32	0.24

See Table 2 for a description of the NACE sectors.

In order to investigate the extent to which restructuring leads to significant regional disparities, Table 9 presents the within and between variations of value added at the regional group level, computed from Table 8 as $\Delta \mathrm{TFP}_{it} z_{it-1}/Y_{t-1}$ and $\Delta z_{it} \mathrm{TFP}_{it-1}/Y_{t-1}$, respectively (i.e. normalized per unit of value added of the previous year). The components are calculated on both the balanced and unbalanced samples. One finding is evident: while the within component of variation in value added is relatively similar for the two groups of regions, the negative between component in the other regions is always larger in magnitude, thus providing a key explanation for the observed divergence in income. In addition, the difference seems to be mostly driven by the behaviour of multinational firms. In both the balanced and unbalanced samples, in fact, MNEs in the lagging-behind regions show a downsizing of inputs which is significantly higher than the one of their counterparts in the Top 3 group, especially in the first 3 years of the time span, i.e. in the early stages of transition. A possible explanation for this finding is related to the initial regional distribution of economic activities prevailing in Romania, together with the heterogeneous characteristics of incumbent firms across regions. For instance, in lagging-behind regions MNEs have prevalently acquired domestic firms operating in high-scale capital intensive industries,

robustness check we have recalculated the decompositions considering the Bucuresti region separately from the other Top 3 ones, given the predominant role of the capital region in driving regional disparities. The results, however, do not change, i.e. the different elements of the decomposition follow similar dynamics when the Top 3 regions are considered jointly or they are splitted considering Bucuresti separated from Vest and Centru.

Table 8. The decomposition of value added—yearly changes in percentage terms, regional clusters

	ΔVA_t	Within ($z_{t-1} * \Delta TFP_t$)			Between ($TFP_{t-1} * \Delta z_t$)			Covariance ($\Delta TFP_t * \Delta z_t$)			Net entry		
	All firms	Dom	MNEs	All firms	Dom	MNEs	All firms	Dom	MNEs	All firms	Dom	MNEs	All firms
Top 3 regions													
1997	−360,690	−0.34	−0.21	−0.55	−0.33	−0.31	−0.64	0.09	0.05	0.14	0.02	0.03	0.04
1998	−46,218	−0.52	−0.44	−0.96	−0.13	−0.08	−0.21	−0.10	−0.15	−0.25	0.12	0.30	0.42
1999	−57,060	−0.39	−0.42	−0.81	−0.16	−0.08	−0.24	−0.05	−0.06	−0.11	0.02	0.14	0.16
2000	−45,225	−0.46	−0.33	−0.79	−0.08	−0.08	−0.17	−0.05	−0.09	−0.14	−0.01	0.11	0.10
2001	−2925	−1.94	1.31	−0.64	0.96	0.17	1.13	−1.50	−1.33	−2.83	1.04	0.30	1.34
Other regions													
1997	−550,450	−0.30	−0.17	−0.47	−0.34	−0.36	−0.70	0.10	0.05	0.15	0.00	0.03	0.03
1998	−100,686	−0.32	−0.30	−0.62	−0.15	−0.29	−0.44	−0.08	0.00	−0.08	0.07	0.07	0.14
1999	−98,710	−0.39	−0.19	−0.57	−0.21	−0.22	−0.43	−0.01	−0.04	−0.05	−0.01	0.06	0.05
2000	−55,249	−0.47	−0.29	−0.76	−0.14	−0.08	−0.22	−0.03	−0.08	−0.11	0.02	0.07	0.09
2001	−18,549	−0.44	−0.08	−0.52	0.18	0.22	0.40	−0.25	−0.57	−0.82	−0.04	−0.02	−0.06

Table 9. Regional disparities and restructuring rates (within and between component)

	All firms		Domestic		Foreign	
	Top 3	Others	Top 3	Others	Top 3	Others
Within component, value added, unbalanced sample						
1997	−0.27	−0.26	−0.33	−0.29	−0.21	−0.21
1998	−0.13	−0.14	−0.14	−0.14	−0.12	−0.15
1999	−0.16	−0.16	−0.17	−0.20	−0.16	−0.12
2000	−0.17	−0.18	−0.21	−0.21	−0.13	−0.14
2001	−0.01	−0.05	−0.09	−0.09	0.04	−0.02
Within component, value added, balanced sample						
1997	−0.27	−0.24	−0.33	−0.30	−0.20	−0.18
1998	−0.18	−0.17	−0.18	−0.18	−0.18	−0.16
1999	−0.19	−0.16	−0.17	−0.20	−0.21	−0.11
2000	−0.19	−0.19	−0.23	−0.19	−0.15	−0.19
2001	−0.01	−0.08	−0.09	−0.12	0.06	−0.03
Between component, value added, unbalanced sample						
1997	−0.32	−0.38	−0.32	−0.34	−0.32	−0.43
1998	−0.03	−0.10	−0.04	−0.06	−0.02	−0.14
1999	−0.05	−0.12	−0.07	−0.11	−0.03	−0.14
2000	−0.04	−0.05	−0.04	−0.06	−0.03	−0.04
2001	0.02	0.04	0.04	0.04	0.01	0.05
Between component, value added, balanced sample						
1997	−0.36	−0.42	−0.34	−0.37	−0.38	−0.46
1998	−0.04	−0.12	−0.04	−0.08	−0.04	−0.18
1999	−0.09	−0.16	−0.12	−0.13	−0.05	−0.20
2000	−0.08	−0.07	−0.07	−0.10	−0.08	−0.04
2001	−0.04	0.01	−0.02	−0.01	−0.05	0.02

The 'within component' captures the effect of changes in productivity within firms, while holding the level of inputs fixed ($z_{t-1} * \Delta\text{TFP}_t$). The 'between component' reflects instead changes in employed inputs, holding fixed the productivity level ($\text{TFP}_{t-1} * \Delta z_t$). Restructuring rates are calculated as the average component (as retrieved from Table 8) per unit of value added in the previous year.

traditionally characterized by higher restructuring rates during transition.[32] As a result, the downsizing activity induced by foreign MNEs in those regions has been relatively more pronounced, largely contributing to the emergence of regional disparities.[33]

In conclusion, although we have found some evidence in favour of the standard drivers of regional inequalities, our analysis shows that the rise in territorial disparities in Romania is mainly driven by the restructuring activities of heterogeneous incumbent firms across regions. Thus, disparities are in large part endogenous to the interaction of firm-level dynamics with market conditions. We can reinterpret this finding in the framework of the simple two-regions example outlined in the introduction. In the

32 For example, 39% of the output of the largest MNEs in lagging behind regions is concentrated in the manufacturing of metal products, machinery and transport equipment (NACE 27, 29 and 34, respectively) versus 11% in the Top 3 regions.

33 Nevertheless, even controlling for the latter effect of industrial specialization, we still find that, within each industry, MNEs in underperforming regions tend to show on average deeper downsizing rates and a larger average size versus their counterparts operating in the Top3 regions. Detailed results are available on request.

case of Romania, the exogenous shock is constituted by the beginning of transition from plan to market. Given the initial distribution of sectors and heterogeneous firms, the latter have started to adjust differently to the new market scenario through restructuring. Cross-regional differences in this adjustment process have largely driven, by themselves, the rise in inequalities, while the standard channel of firm entry has played only a minor role.

4.1. The long-run dynamics of regional growth

The above findings are *prima facie* reassuring from a policy point of view: as soon as the diverging restructuring process of incumbent firms in the lagging-behind regions is over, the rise in inequalities should slow, while a policy action aimed at correcting the initial imbalances in the presence of MNEs might restore a convergence process. Puga (1999), for instance, shows how regional disparities can be reduced over time through firms' relocation when labour is imperfectly mobile and wages are flexible. Nevertheless, regional inequalities might tend to persist in the long run if eventual spillovers from foreign MNEs' affiliates to domestic firms are biased towards the Top 3 regions.[34]

In order to investigate the likelihood of such an outcome, we thus explore the link between the presence of foreign MNEs and the productivity performance of domestic firms across the regional groups. In particular, we follow the approach of Smarzynska Javorcik (2004) who, working on Lithuanian regional data and exploiting a measure of firm level productivity similar to ours, has detected significant positive spillovers arising through backward linkages, i.e. generated through contacts between multinational affiliates and local input suppliers and no clear evidence of spillovers neither intra-industry nor through forward linkages.

The baseline specification of our econometric model is:

$$\begin{aligned}\Delta\omega_{ijrt} &= \alpha_0 + \alpha_1 \mathrm{HP}_{jr(t-1)} + \alpha_2 \mathrm{BP}_{jr(t-1)} + \alpha_3 \mathrm{FP}_{jr(t-1)} \\ &\quad + \alpha_4 X_{j(t-1)} + \alpha_5 Z_i + \alpha_t + \alpha_r + \alpha_j\end{aligned} \tag{7}$$

where i denotes the firm, j the industry and r the region at year t, on the basis of the classification of our dataset. The dependent variable $\Delta\omega_{ijrt}$ is the change (in logs) of the TFP undergone by firm i, in sector j and region r, from year $(t-1)$ to year t, calculated according to the Levinsohn and Petrin (2003b) methodology previously discussed, and used for our decompositions.

To measure eventual spillovers, we regress the change in the TFP of domestic firms over three foreign penetration indexes. In particular, HP_{jrt} is an index of horizontal penetration, capturing the intra-industry presence of MNEs and calculated as the ratio of multinational employees over total employment in the considered industry j, region r and year t. The index BP_{jrt} measures the foreign presence in industries from which industry j's domestic firms are sourcing their inputs, thus accounting for forward linkages from MNEs to domestic firms. It is computed as the weighted sum of the horizontal penetration figures of all the suppliers' industries, according to the formula $\mathrm{BP}_{jrt} = \sum_{k(if\, k\neq j)} \alpha_{jk}\ \mathrm{HP}_{krt}$, where α_{jk} is the proportion of industry j's total

34 See the survey by Gorg and Greenaway (2004) for an analysis of the evidence on MNEs' spillovers.

inputs sourced from industry k, an information retrieved from the 1998 Romanian input–output matrix. Analogously, the index FP_{jrt} measures the presence of multinationals' affiliates in industries that are sourcing inputs from sector j, thus accounting for backward linkages from MNEs to domestic firms. Specularly to the BP index, it is defined as $FP_{jrt} = \sum_{m\ (if\, m \neq j)} \beta_{jm}\, HP_{mrt}$, where β_{jm} is the proportion of output sold from industry j to m, out of industry j's total sales.[35]

The covariates $X_{j(t-1)}$ control for the market structure that might affect the domestic firms' productivity: in particular, we have included in the specification for each industry j the Herfindahl Index, calculated using the market shares of all the sample's firms, and the minimum efficient scale, proxied by the median firms' employment. Both covariates enter in the regression with their lagged values. Firm-specific heterogeneity in the dependent variable is also captured by two different proxies Z_i. In one specification, we introduce the variable measuring the year of entry of each firm, which allows us to test for eventual structural differences in the productivity performance of different cohorts of entrants; in the other specification, we control for the initial level of TFP of the domestic firms in the year of entry, thus testing whether initially less productive firms tend to experience higher productivity growth rates.

The specification reported in Equation (7) allows us to control for endogeneity and the unobserved firm, time, region and industry-specific characteristics that might affect the correlation between firm productivity and foreign presence. We deal with these issues by lagging one period the penetration indexes, by first differencing the dependent variable and by including the time, region and industry fixed effects α_t, α_r and α_j.[36] Another typical econometric concern of this kind of estimates, i.e. the simultaneity bias in the measure of firm-level productivity, is addressed using the already discussed Levinsohn and Petrin (2003b) methodology in order to calculate firm-level productivity estimates. Finally, since we perform a regression on micro units using mainly aggregate variables as covariates (at the regional and industry level) we control for the potential downward bias by clustering the standard errors for all firm-level observations belonging to the same region-industry pair.

The first two columns of Table 10 simply prove the better productivity performance of MNEs with respect to domestic firms, regressing the (log) change in productivity for all firms (domestic and MNEs) on a dummy *foreign*, which takes value 1 if the considered firm is a foreign owned multinational. Not surprisingly, the dummy is always positive and significant, even when controlling for fixed effects and the other covariates. The spillover regression is presented, for all regions pooled, in the third to fifth column of Table 10. As it can be seen, we can exclude at the national level a negative effect accruing to domestic firms from the presence of MNEs. Actually, if anything, we find hints of positive horizontal spillovers, robust to the inclusion of covariates controlling for the underlying market structure and domestic firms' heterogeneity.

35 Clearly, in the calculation of both the BP and FP indexes we have always excluded from the computation the inputs supplied and sourced within the same industry in order to avoid a double counting of the foreign presence, since potential intra-industry effects are already taken into account by the HP index.

36 Contrary to standard practice, we have opted to lag, not to time-difference, the covariates related to the MNEs' presence. In fact, first differencing the covariates imposes the assumption that changes in productivity of domestic firms are driven only by changes in the presence of MNEs, which is not necessarily true, since domestic firms might be affected differently by the same stock of MNEs over time, e.g. due to a learning process or threshold effects.

Table 10. Spillover analysis—all regions

Dep var: Δln(TFP)	All firms	All firms	Domestic firms	Domestic firms	Domestic firms
Dummy MNE	0.025***	0.024***	–	–	–
	(0.007)	(0.007)			
HP_{t-1} (horizontal linkages)	–	–	0.013**	0.02***	0.013*
			(0.007)	(0.007)	(0.007)
BP_{t-1} (forward linkages)	–	–	−0.028	0.014	−0.028
			(0.019)	(0.019)	(0.019)
FP_{t-1} (backward linkages)	–	–	−0.016	0.012	−0.02
			(0.04)	(0.041)	(0.042)
Herfindahl_{t-1}	–	−0.138	–	−0.129	−0.169
		(0.137)		(0.128)	(0.133)
Median employment_{t-1}	–	−0.002	–	0.007***	0.002
		(0.003)		(0.002)	(0.003)
Initial TFP level	–	–	–	−0.150***	–
				(0.004)	
Year of entry	–	0.005***	–	–	0.002
		(0.001)			(0.001)
Region dummies	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Industry dummies	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Time dummies	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
No. of obs	113,159	113,159	97,799	97,799	97,799
Wald χ^2 of joint signif.	***	***	***	***	***

Semi-robust standard errors in parentheses, clustered for region-industry pairs. ***, ** and * significant at the 1, 5 and 10% level.

In Table 11, we present the results of the spillover regression differentiated for the two groups of regions previously discussed, both within and across regions (from the Top 3 to the other regions). As it can be seen, in the top three regions we detect positive horizontal spillovers as well as a positive effect on productivity changes from MNEs sourcing their products from domestic firms (backward linkages). None of these effects is instead present in the under-performing regions [Table 11 (within regions)]. Moreover, we find that the presence of MNEs in the Top 3 regions tends to be negatively associated with the productivity performance of domestic firms in the lagging behind regions [Table 11 (across regions)].[37]

Putting things together, a third general conclusion can be inferred from our analysis: the effects of foreign MNEs' affiliates on domestic firms are heterogeneous across regions. In particular, positive spillovers are detected only within the Top 3 Romanian regions; moreover, we find evidence of negative spillovers from the MNEs located in the best performing regions towards domestic firms in the other regions. The latter unbalanced effects induced by the presence of foreign investment could contribute to the eventual long run persistence of regional inequalities after the end of the transition process.

37 These findings are robust to different specifications of the productivity variable, i.e. measured through the modified Levinsohn and Petrin (2003b) semi-parametric estimates augmented with regional fixed-effects or through standard OLS techniques.

Table 11. Spillover analysis—regional clusters

Dep var: Δln(TFP) *Domestic firms*	Top 3 regions	Top 3 regions	Top 3 regions	Other regions	Other regions	Other regions
WITHIN REGIONS						
HP_{t-1} (Horizontal linkages)	0.037***	0.038***	0.037***	0.005	0.011	0.003
	(0.012)	(0.013)	(0.012)	(0.009)	(0.010)	(0.009)
BP_{t-1} (Forward linkages)	−0.056	0.004	−0.057	−0.026	0.004	−0.028
	(0.046)	(0.045)	(0.045)	(0.019)	(0.019)	(0.021)
FP_{t-1} (Backward linkages)	0.098**	0.132***	0.099*	−0.058	−0.023	−0.069
	(0.051)	(0.048)	(0.053)	(0.074)	(0.079)	(0.077)
$Herfindahl_{t-1}$	–	−0.034	−0.05	–	−0.207	−0.266
		(0.176)	(0.167)		(0.186)	(0.205)
Median $employment_{t-1}$	–	0.004	−0.001	–	0.008**	0.004
		(0.003)	(0.004)		(0.003)	(0.003)
Initial TFP level	–	−0.154***	–	–	−0.148***	–
		(0.007)			(0.004)	
Year of entry	–	–	0.002	–	–	0.001
			(0.003)			(0.002)
Region dummies	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Industry dummies	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Time dummies	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
No. of obs.	38,547	38,547	38,547	59,252	59,252	59,252
Wald χ^2 of joint signif.	***	***	***	***	***	***
ACROSS REGIONS						
HP_{t-1} (Horizontal linkages) in Top 3 regions				−0.045*	−0.045*	−0.049*
				(0.026)	(0.026)	(0.027)
BP_{t-1} (Forward linkages) in Top 3 regions				−0.668***	−0.523***	−0.651***
				(0.127)	(0.117)	(0.118)
FP_{t-1} (Backward linkages) in Top 3 regions				−0.596***	−0.599***	−0.624***
				(0.141)	(0.135)	(0.142)
$Herfindahl_{t-1}$				–	−0.201	−0.261
					(0.183)	—(0.204)
Median $employment_{t-1}$				–	0.009***	0.004
					(0.003)	(0.003)
Initial TFP level				–	−0.147***	–
					(0.004)	
Year of entry				–	–	0.001
						(0.002)
Region dummies				*Yes*	*Yes*	*Yes*
Industry dummies				*Yes*	*Yes*	*Yes*
Time dummies				*Yes*	*Yes*	*Yes*
No. of obs.				59,252	59,252	59,252
Wald χ^2 of joint signif.				***	***	***

Semi-robust standard errors in parentheses, clustered for region-industry pairs. ***, ** and * significant at the 1, 5 and 10% level.

5. Conclusions

In this article, we have performed a microfounded analysis of regional disparities, based on the aggregation of firm-level observations. At this purpose, in Section 2 we have adapted to the regional case a growth accounting methodology

(Levinsohn and Petrin, 2003a) which, starting from firm-level data, allows to decompose and reaggregate output and value added across industries and classes of firms, and thus makes it possible to track the micro sources of growth and regional disparities controlling for the heterogeneity in firms' characteristics.[38]

In Section 3, the methodology has been applied to the case of Romania, a transition economy characterized by increasing regional divergences. At the national level, results from the decomposition show that most of the U-shaped negative variations in value added are related to the restructuring process of firms. This is captured by the within and between components of the decomposition, which reflect, respectively, changes in productivity and employed inputs of existing firms. Net entry of firms has been found to play a less important role. The decomposition has also allowed us to separately track the performance of domestically and foreign owned firms. We have found that heterogeneity in ownership matters, since a significant role in the growth dynamics is played by foreign MNEs' affiliates, which are outperforming their local counterparts in terms of productivity changes and net entry. These findings are consistent with various strands of literature on transition countries, an indication that the methodological framework allows us to microfound the sources of growth analysed in the macro literature (technological diffusion and industrial restructuring) without distortions.

In Section 4, the value added decomposition has been performed separately for two groups of regions displaying diverging income performances over the time-span: over-performing versus other regions. This has allowed us to precisely identify the microsources of the emerging regional disparities. The latter are mainly driven by the diverging dynamics of the between component (especially for foreign MNEs) in different areas of the country, partly associated with an unfavourable sectoral specialization in the group of underperforming regions. Standard channels driving regional disparities (workers' reallocation and firm entry) are instead responsible only to a lesser extent for the detected divergence. Thus, the emergence of regional inequalities in Romania seems to be in large part endogenous to the interaction of firm-level dynamics and market conditions, as a result of the shock of transition from plan to market.

Finally, we have also investigated, through panel-data econometrics, the presence of productivity spillovers stemming from foreign owned to domestic firms, finding unbalanced effects across groups of regions. While domestic firms in the over-performing regions are found to benefit from the presence of foreign MNEs' affiliates, the same cannot be said for their counterparts in the lagging-behind areas of the country. This could contribute to the eventual long run persistence of regional inequalities after the end of the transition process.

These findings are of course specific to the analysed country and transition experience. However, at a more general level, they open the way for further theoretical research aimed at exploring the role of firm heterogeneity in a NEG framework, in line with a recent attempt by Baldwin and Okubo (2006). In particular, it would be interesting to look at models in which, after a shock, inequalities can in principle arise only due to the initial firms' distribution, without necessarily relying on cross-regional reallocations of firms.

38 Clearly, the same micro-based framework can be applied to cross-industries or cross-countries comparisons according to the different research and policy objectives, provided that suitable firm-level data can be exploited.

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Annexe 1

The validation of the dataset

The dataset, retrieved from the census of Romanian firms through AMADEUS, includes those firms in the manufacturing and construction industries for which at least one observation of revenues is available over the period 1996–2001 and information is provided in terms of ownership. This yields a coverage of 95% of all official active firms operating in Romania in manufacturing and construction, with the exception of 2001, where this percentage drops to 85% (see Table A1.1). The coverage is however lower if one considers only those firms for which information is available for all the variables of interest in the calculus of TFP, due to missing observations. In particular, after cleaning for some outliers in the same variables, the coverage with respect to the census of Romanian firms is reported in Table A1.1.

Table A1.1. Firms' sample coverage

Year	Sample coverage	TFP sample coverage
1996	0.97	0.42
1997	0.96	0.46
1998	0.96	0.48
1999	0.96	0.49
2000	0.94	0.50
2001	0.85	0.47

A crucial point for our analysis is the ability of the restricted sample to reproduce without biases the evolution of regional disparities in Romania. There are two sources of potential distortions: first of all, we have restricted the analysis to the manufacturing and construction industries only, while official regional disparities reported in Table 1 are measured using regional per capita GDP figures including all industries; second, the missing observations in our sample might be not randomly distributed, but rather concentrated in some regions. To assess these concerns, we present in what follows a Table A1.2 reporting the official figures of regional gross value added per capita, in manufacturing and construction only (provided in nominal euros by the Romanian statistical office).

Table A1.2. Regional GVA in manufacturing and construction, official data, in percentage of national average

	1996	1996	1997	1998	1999	2001
RO-01	0.76	0.78	0.78	0.72	0.73	0.71
RO-02	1.02	0.99	1.00	1.07	0.89	0.96
RO-03	0.98	0.97	0.92	0.92	0.89	1.00
RO-04	0.81	0.79	0.83	0.79	0.78	0.78
RO-05	1.01	1.00	0.99	0.91	1.31	1.03
RO-06	0.86	0.88	0.89	0.92	0.89	0.85
RO-07	1.21	1.24	1.25	1.23	1.19	1.19
RO-08	1.52	1.52	1.54	1.63	1.66	1.70

Table A1.3. Regional GVA in manufacturing and construction, restricted sample, in percentage of national average

	1996	1996	1997	1998	1999	2001
RO-01	0.88	0.80	0.74	0.71	0.70	0.65
RO-02	0.81	0.91	0.83	0.78	0.81	0.72
RO-03	1.03	0.89	0.86	0.82	0.79	0.78
RO-04	0.51	0.55	0.48	0.48	0.44	0.39
RO-05	0.67	0.70	0.77	0.84	0.90	1.08
RO-06	0.90	0.97	1.04	1.02	1.02	1.07
RO-07	0.80	0.82	0.81	0.82	0.85	0.94
RO-08	2.54	2.60	2.78	2.92	2.90	2.84

The correlation between Table A1.2 and the official regional GDP figures for all industries reported in Table 1 in the article is 0.89, i.e. the dynamics of regional disparities emerging in Romania when considering only the manufacturing and construction industries are highly correlated with the ones emerging when considering the entire set of economic activities. Analogously, we report a Table A1.3, where regional gross value added in manufacturing and construction is measured as the sum of the value added of all the individual firms operating in each region, this time retrieved from our restricted sample, and then divided by the region's population to retrieve the per capita figures. Again, the correlation between this Table A1.3 and the official regional GDP figures for all industries reported in Table 1 in the article is 0.87, i.e. we have evidence that our restricted sample can reproduce the evolution of regional disparities in Romania.

Given the nature of our data, another concern is related to our measurement of exit rates, since we have considered as exiting those firms that do not report any information after a given year. Clearly, by using the latter criterion, it could be the case that a firm has exited from the dataset, but not from the market. However, our exit rates so calculated are in line with the ones reported from official statistics for Romania (data available from the Romanian Chamber of Commerce), as shown in Table A1.4.

Table A1.4. Official and sample exit rates

Year	Official exit rate (%)	Sample exit rate (%)
1997	7	4
1998	7	5
1999	6	6
2000	9	7
2001	10	10

It remains to be discussed how properly we are able to tackle the issue of firms' ownership within our dataset. To this extent, we have included in the sample only those firms for which detailed information on the ownership structure is available: in particular, we have considered a firm as foreign if more than 10 per cent of its capital belongs to a foreign MNE and domestic otherwise. Ownership information is available for most firms of the census, but this information refers only to the year 2000/2001. Since we rely on this information in order to attribute ownership, we have to assess the probability of a change in ownership in the previous years to avoid a biased attribution. To this extent we have compared different yearly releases of AMADEUS. Due to the limited coverage of earlier versions of the dataset we have been able to identify a smaller sample of firms (802 firms, of which 711 domestic and 91 multinationals) for which it is possible to track the entire ownership history for the period 1997–2000. In particular, 17 of the 711 domestic firms that we tracked became multinationals by the year 2000, while only three MNEs on 91 switched to a domestic status.

Annexe 2

Levinsohn and Petrin (2003b) productivity estimates

Let y_t denote (the log of) a firm's output in a Cobb-Douglas production function of the form

$$y_t = \beta_0 + \beta_l l_t + \beta_k k_t + \beta_m m_t + \omega_t + \eta_t \tag{A2.1}$$

where l_t and m_t denote the (freely available) labour and intermediate inputs in logs, respectively, and k_t is the logarithm of the state variable capital. The error term has two components: η_t, which is uncorrelated with input choices, and ω_t, a productivity shock unobserved by the econometrician, but observed by the firm. Since the firm adapts its input choice as soon as it observes ω_t, inputs turn out to be correlated with the error term of the regression and thus OLS estimates of production functions yield inconsistent results.

To correct for this problem, Levinsohn and Petrin (2003b), from now on LP, assume the demand for intermediate inputs m_t (e.g. material costs) to depend on the firm's capital k_t and productivity ω_t, and show that the same demand is monotonically increasing in ω_t. Thus, it is possible for them to write ω_t as $\omega_t = \omega_t(k_t, m_t)$, expressing the unobserved productivity shock ω_t as a function of two observables, k_t and m_t.

To allow for identification of ω_t, LP follow Olley and Pakes (1996) and assume ω_t to follow a Markov process of the form $\omega_t = E[\omega_t|\omega_{t-1}] + \xi_t$, where ξ_t is a change in productivity uncorrelated with k_t. Through these assumptions it is then possible to rewrite Equation (A2.1) as

$$y_t = \beta_l l_t + \phi_t(k_t, m_t) + \eta_t \tag{A2.2}$$

where $\phi_t(k_t, m_t) = \beta_0 + \beta_k k_t + \beta_m m_t + \omega_t(k_t, m_t)$. By substituting a third-order polynomial approximation in k_t and m_t in place of $\phi_t(k_t, m_t)$, LP show that it is possible to consistently estimate the parameter $\widehat{\beta_l}$ and $\widehat{\phi_t}$ in Equation (A2.2). For any candidate value β_k^* and β_m^* one can then compute a prediction for ω_t for all periods t, since $\widehat{\omega_t} = \widehat{\phi_t} - \beta_k^* k_t - \beta_m^* m_t$ and hence, using these predicted values, estimate $E[\widehat{\omega_t|\omega_{t-1}}]$. It then follows that the residual generated by β_k^* and β_m^* with respect to y_t can be written as

$$\widehat{\eta_t + \xi_t} = y_t - \widehat{\beta_l} l_t - \beta_k^* k_t - \beta_m^* m_t - E[\widehat{\omega_t|\omega_{t-1}}] \tag{A2.3}$$

Equation (A2.3) can then be used to identify β_k^* and β_m^* using the following two instruments: if the capital stock k_t is determined by the previous period's investment decisions, it then does not respond to shocks to productivity at time t, and hence $E[\eta_t + \xi_t | k_t] = 0$; also, if the last period's level of intermediate inputs m_t is uncorrelated with the error period at time t (which is plausible, e.g. proxying intermediate inputs with material costs), then $E[\eta_t + \xi_t | m_{t-1}] = 0$.

Through these two moment conditions, it is then possible to write a consistent and unbiased estimator for β_k^* and β_m^* simply by solving

$$\min_{(\beta_k^*, \beta_m^*)} \sum_h \left[\sum_t (\widehat{\eta_t + \xi_t}) Z_{ht} \right]^2 \tag{A2.4}$$

with $Z_t \equiv (k_t, m_{t-1})$ and h indexing the elements of Z_t.