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Do intergovernmental transfers affect the distribution of manufacturing production across regions in federal countries? Theory and evidence for Argentina

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ABSTRACT
The effect of changes in the distribution of top-to-bottom intergovernmental transfers on the location of manufacturing production is analysed using a modified version of the footloose capital model. An increase in the share of transfers received by a region increases its share of manufacturing production the larger are transaction costs; the larger is the share of transfers going directly to consumers; the larger is the share of manufacturing consumption *vis-à-vis* non-tradable consumption; and the easier consumers can substitute among manufacturing varieties. Using data for Argentina for 1983-2005, the empirical analysis appears to support the existence of two distinctive regimes, with smaller/poorer provinces benefiting in terms of the location of manufacturing production as a response to an increase in transfers. Also, for these provinces, the benefits are greater if they are politically aligned with the federal government, especially through the receipt of discretionary transfers. For large/rich provinces, the evidence is less conclusive.

KEYWORDS Regional economics; federalism; top-to-bottom transfers; manufacturing location

Introduction

Regional public policy is a key instrument in federal countries to address territorial economic disparities and inequalities. The national government uses different policy tools for accomplishing this, the most common being direct public spending, tax policy, subsidies and intergovernmental transfers. Although most federal countries use these to varying degree, intergovernmental transfers are heavily relied upon in countries with stark regional disparities such as Brazil, India and Argentina.[1] Typically, state governments receive cash transfers from the central government. These transfers can be

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automatic or non-automatic; while the first are usually established by law or tax-sharing agreement, non-automatic transfers are often based on political motivations.[2] State governments use both types of transfers to pay for current and capital expenditures, including public goods, social benefits, public employment and infrastructure investment. However, the regional economic effects associated with these may not be the same – that is, raising public employment and wages may have different economic effects as compared to increasing direct pensions and social transfers. In this paper, our focus is on the effect of vertical transfers on the allocation of manufacturing production among the states.

The main intuition is as follows. Imagine a country with a federal government and two regions, each with its own government. An increase in vertical transfers from the federal government to one of the regions has the following effects on that region: firstly, in the very short run, this stream of resources increases regional demand for both tradable and non-tradable goods, increasing goods and factor prices (labour and capital), while regional competitiveness can go in either direction; secondly, gradually in the transition to the long run, there is an incentive for firms to move between regions as long as rates of return to capital differ. As a result, if the initial impact was a decrease in regional competitiveness, capital would move away from the region receiving the transfers, the opposite being true with an initial increase in regional competitiveness.

Our model in the third section formalizes this intuition and outlines the two distinct effects. An initial effect[3] moves all relevant variables (good and factor prices) in the same direction, affecting manufacturing production in the region negatively. This effect occurs in the instantaneous (very short-run) moment through an increase in demand for labour from the non-tradable sector at the expense of the tradable one. As a result, there is an unambiguous negative effect on manufacturing production – that is, not depending on parameter values. Secondly, in response to differences in the rate of return to capital, there is an incentive for firms to move between regions. The direction of this effect is a priori ambiguous and depends on the values of key parameters in our model: while it may offset (maybe partially) the initial negative effect on manufacturing production, it may also reinforce it.

The paper draws from two distinct literatures. Firstly, our paper borrows from the new economic geography (NEG) literature with regional public policy. Martin and Rogers (1995), Martin (1999) and Puga (2002) focus on infrastructure investment and its effects on regional industrial location (and relocation). They conclude that improvements in local (as opposed to interregional) infrastructure in a region are associated with greater relocation of firms. Commendatore et al. (2008a, 2008b, 2014) study the way productive public spending affects industry location, through both demand and productivity effects. They find that the final effect depends on the way productive public spending is financed. Finally, the work by Becker et al. (2013) examines the impact of changes in public sector employment on the spatial distribution of economic activity. Using data for Germany, they find that creating public sector jobs increases private employment.

The paper also borrows from the Dutch disease literature. In the context of fiscal policy, this literature suggests that a windfall of transfers to a region (country) can have a negative impact on the production of tradable goods through an appreciation of the real exchange rate. The 'transfer paradox', as it was originally known, associated aid transfers with adverse effects on relative prices and national competitiveness[4] (Brecher and Bhagwati, 1982; Bhagwati et al., 1983; Yano, 1983). The theory suggests that sustained international (intergovernmental) transfers to a country (region) may produce negative effects on dynamic sectors such as manufacturing through an increase in the price of non-tradable relative to tradable goods. Empirical studies are consistent with the theory (Yano and Nugent, 1999; Rajan and Subramanian, 2008; Doucouliagos and Paldam, 2009, Rajan and Subramanian, 2011; Papyrakis and Raveh, 2014).[5]

Inspired by the Argentine case, where intergovernmental fiscal transfers are among the main sources of regional financing, our paper contributes to both literatures. To the NEG literature, we analyse the case where the effects on industry (re)location are dependent on the type of public expenditure the transfer is used for, rather than on the way it is financed. We also contribute to the Dutch disease literature by studying the case for intergovernmental transfers rather than international aid transfers and by proposing two alternative ways of implementing the transfer. We look empirically at the implications of the theoretical model using data for Argentina. Our paper offers a novel explanation for the way regional public policy operates and affects the distribution of economic activity in a federal system.

The rest of the paper is organized as follows. In the second section, we outline the problem and the main theoretical intuition. In the third section, we present a model inspired on the NEG literature to highlight the potential relationship between the regional distribution of transfers and that of manufacturing production. The fourth section solves the model numerically to analyse the forces behind that relationship. In the fifth section, we characterize the Argentine system and present data and results. The sixth section concludes.

Vertical transfers, regional effects and industry location

Top-down intergovernmental transfers can be thought of as a stream of financial resources going to the regions (states). Regional governments may use these funds to increase current public spending, to build infrastructure or to give direct subsidies to citizens. We argue that the effect of such transfers on industry location depends on what these transfers are used for. Previous related research (Commendatore et al., 2008b) focused on whether industry location is affected depending on the way productive public spending is financed with regional taxes. Our paper examines whether the way regional transfers are spent has an effect on industry location: there is a demand effect in our paper, but no productivity effect; the effectiveness of regional transfers depends crucially on the consumption patterns of the regions; regional spending on tradable goods (manufacturing) is more likely to attract manufacturing firms than spending on non-tradable goods (public sector). This has direct implications for the competitiveness of the region receiving these transfers.

The main interest in our paper is the relationship between intergovernmental transfers and manufacturing location. However, such transfers have been examined in relation to other economic and political outcomes. One long-standing tradition in this literature links vertical federal transfers with undesired effects on regional markets in terms of resource allocation. Scott (1950) and Buchanan (1952) suggest that equalizing grants that redistribute income from rich to poor regions introduces inefficiencies in the allocation of resources, particularly labour markets. Some recent papers have offered additional theoretical explanations and supportive empirical evidence. Desai et al. (2005) examine how regions benefiting from unearned vertical transfers are able to shelter from market forces using these transfers to preserve rents and quasi-rents. Capello et al. (2009) suggest another mechanism linking transfers with increases in public employment. Controlling for several variables, the authors find a significant wage premium in the public sector relative to the private sector.[6] They suggest that transfers used to increase public employment and wages create a sort of crowding-out mechanism that affects private employment negatively.

Figure 1 shows additional evidence linking transfers with regional labour markets, specifically public employment by provincial governments and wages. Accounting for population, provinces with higher transfers have higher public employment and wages. Figure 1 contains four plots, each correlating transfers with public employment/public wages with two different groupings of provinces: the left panels show this correlation for provinces according to their population and GDP size, while the right panels use Giraudy's (2010) classification between subnational undemocratic regimes (SUR) and subnational democratic regimes (SDR).[7]

All graphs show that there is a positive pairwise correlation between provincial revenues coming from the national level (both revenues automatically allocated by the tax-sharing law and current transfers) and public employment and wages. Interestingly, the left panels show that provinces with a large population and high GDP have the smallest transfers and public employment (in per capita terms) and wages. The right panels show that provinces with undemocratic regimes have the largest transfer and public

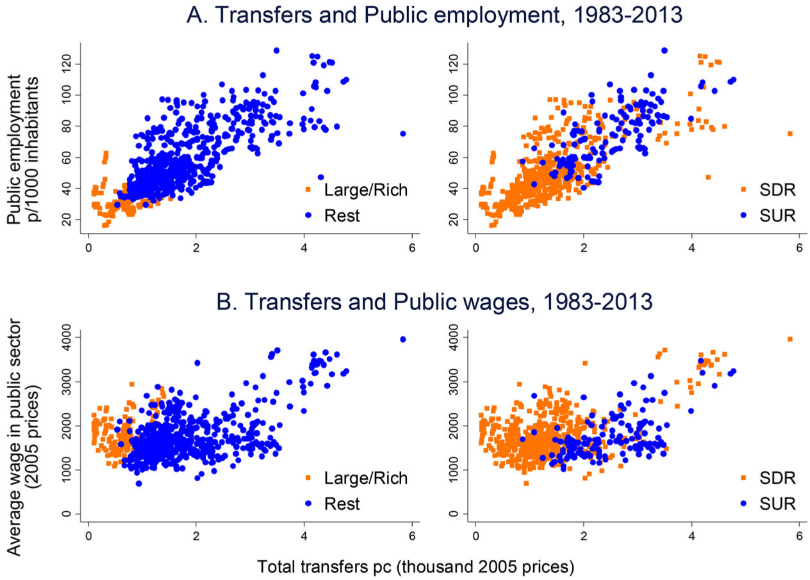

Figure 1. Total transfers and provincial public employment wages.

employment/wages. The graphs suggest that although there is an overall positive correlation between transfers and public employment and wages, this correlation seems to be stronger for the group of provinces with SUR and those with populations and GDP below the national average.

Another interesting pattern, and even when there apparently is an important heterogeneity across provinces, is that there does not appear to be any relationship between the level of transfers and the relative wage between public and private sectors (see Figure 2). This result can be explained because in each province, public and private sectors compete for a common pool of workers, so the latter needs to match the wages paid by the former, or at least do not deviate much from them. This finding would be in line with the intuition behind our modelling strategy, as explained above.

A more recent literature embedded in the political science and political economy tradition has stressed that vertical transfers have strong effects on regional institutional characteristics and political outcomes. Gervasoni (2010) links theoretically and empirically the magnitude and origin of a region's fiscal resources to the preservation of economic and political rents within that region. In a similar vein, Giraudy (2009, 2010, 2013) argues that SUR arise due to the excessive financial dependence on the federal government. Bonvecchi and Lodola (2011), Jones et al. (2012) and Ardanaz et al. (2014) offer theoretical insights and evidence on the political economy of intergovernmental transfers, linking electoral outcomes to vertical fiscal transfers. These papers have all examined the Argentine case.[8]

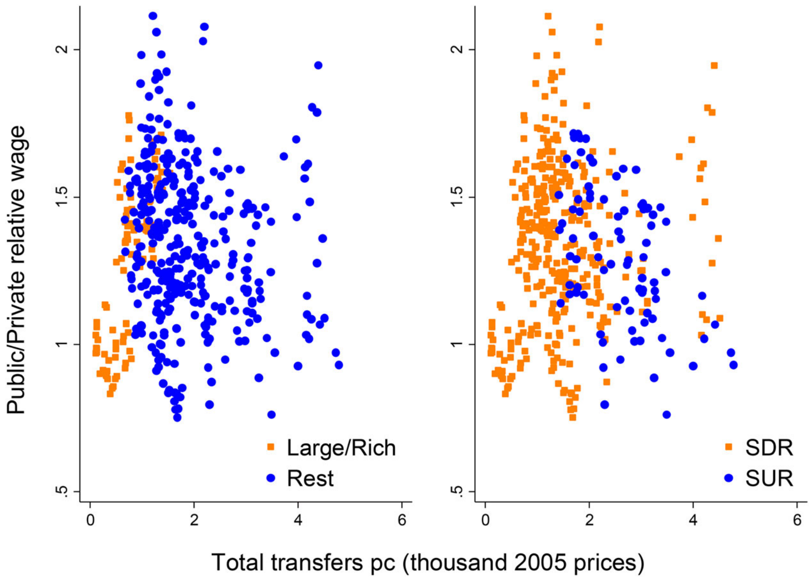

Figure 2. Total transfers and relative public/private wages, 1995–2013.

On the basis of these ideas and the evidence given above, we provide an explanation of why vertical federal transfers to a region in a federal setting may not be associated with an increase in manufacturing production and may even have a negative effect. The mechanism and channels we examine are somewhat different from those proposed in the literature: these are not directly related to labour markets or to the extent of political resources of regional governments, but rather to regional consumption patterns and to the way transfers are allocated in a federal system.

We adapt Martin and Rogers' (1995) footloose capital model (FCM) to include non-tradable goods and public employment in order to examine the effect of changes in the distribution of transfers on the distribution of manufacturing production between regions. Our model shows that an increase in transfers to a region does not always have a positive effect on its share of manufacturing production. Indeed, the model predicts that an increase in the share of transfers going to a region has a positive effect on its share of manufacturing production, the larger are the transaction costs, the larger is the share of transfers going directly to consumers (direct transfers),[9] the larger is the share of manufacturing consumption *vis-à-vis* non-tradable consumption and the larger the elasticity of substitution between manufacturing goods.

At a first glance, the empirical analysis (weakly) supports the claim that for Argentina the location of manufacturing production is negatively related to the regional distribution of transfers, especially for the case of untied transfers. However, further analysis shows that this result may be biased because Argentine provinces do not constitute a homogeneous group, but rather can be grouped into two regimes: small and low-income provinces and large and high-income provinces. For the first group of provinces, the effect of higher transfers is positive, especially when they are politically aligned with the federal government.

A model of transfers and location of manufacturing production

The model presented in this section is an extension of Martin and Rogers' (1995) FCM and shows how changes in the distribution of transfers from federal to state governments affect the regional location of manufacturing production. We extend the FCM by including in each region a sector that produces a non-traded good and a state government which uses public resources to hire public employment.

The model includes two regions. In each of them, there are a tradable sector (producing manufactures) and a non-tradable sector. The non-traded goods are produced with identical technologies and under constant returns to scale (CRS) using only labour (L), while the production of manufactures presents increasing returns to scale (IRS) and uses capital (K) as a fixed cost and labour (L) as a variable cost.[10] The market for manufactures is monopolistically competitive *à la* Dixit–Stiglitz, where each firm produces a differentiated variety. Trade of manufactures between the two regions is subject to iceberg-type transportation costs.[11] In each region, the non-traded good is sold in perfectly competitive markets and can only be traded in the region it is produced. We assume that labour is perfectly mobile between sectors but immobile between regions; capital, on the other hand, is mobile between regions.

There are two levels of government: one federal government and two regional governments. The federal government taxes all capital revenues[12] and redistributes them among the regions. These transfers can be allocated directly to the regional governments or given directly to consumers. Regional governments use all transfers to hire public employees;[13] this assumption may seem extreme, but it enables us to exclude the public sector in having a role on the relative demand for the different goods. Since we are not interested in pursuing a welfare analysis, we can assume, without loss of generality, consumers get no utility from public goods produced with public employment.

Consumers[14]

Consumers in each region have a two-tier utility function. The first tier takes a Cobb–Douglas form, and is defined over the consumption of the non-traded good and a composite of manufactures. The utility of a representative consumer living in region i is:

$$u_i = (c_{NT,i})^{\beta_{NT}} (c_{M,i})^{\beta_M} \text{with } \beta_{NT} + \beta_M = 1, \tag{1}$$

where $c_{NT,i}$ is the per-capita consumption of the non-traded good produced in region i, and $c_{M,i}$ is the per-capita consumption of a composite of manufactures. β_{NT} and β_M are the expenditure shares each consumer spends on the consumption of each type of good.

The $c_{M,i}$ composite takes the following constant elasticity of substitution form:

$$c_{M,i} = \left[\sum_{h\in N} c_i(h)^{\alpha}\right]^{1/\alpha} \quad 0 < \alpha < 1, \tag{2}$$

where $c_i(h)$ is the units consumed of any given variety h, and $N = n_i + n_j$ is the total number of manufactured varieties, where n_i and n_j are the number of varieties produced in regions i and j, respectively.

From the consumer maximization problem, we have that the consumption of each manufactured variety by all consumers living in region i is equal to:

$$C_i = \frac{(pT_i^j)^{-\sigma}}{(PM_i)^{1-\sigma}}\beta_M E_i \quad \sigma = \frac{1}{1-\alpha} > 1, \tag{3}$$

where pT_i^j is the consumer price of a variety consumed in region i and produced in region j, PM_i is the manufacture price index in region i, E_i is the total income[15] of consumers living in region i and σ is the elasticity of substitution between manufactured varieties.[16] The assumption that trade of manufactures is subject to iceberg-type transportation costs means the following relationships between producer and consumer prices:

$$\begin{aligned} pT_i^j &= pT^j \quad \text{if} \quad i = j, \\ pT_i^j &= \tau pT^j \quad \text{if} \quad i \neq j, \end{aligned} \tag{4}$$

where τ are the iceberg transaction costs, and pT^i and pT^j are the producer prices in regions i and j, respectively. The notion of iceberg transaction costs means that for one unit consumed in region i, $\tau > 1$ units need to be shipped from j.

Total consumption of the non-traded good is equal to:

$$C_{NT,i} = \frac{\beta_{NT} E_i}{pNT_i}, \tag{5}$$

where pNT_i is the price of the non-traded good in region i.

Producers

Non-traded goods use only labour and are produced with CRS:

$$NT_i = LNT_i, \tag{6}$$

where LNT_i are the units of labour used in production by the non-traded sector in region i. From the producer problem, the price of the non-traded good is:

$$pNT_i = w_i, \tag{7}$$

where w_i is the wage rate in region i.

Manufactures use capital and labour. The total cost of producing any given variety in region i is given by:

$$CT_i = \pi_i F + a w_i x_i, \tag{8}$$

where F is the capital requirement, not dependent on the production scale x_i; a is the labour requirement for each unit of production and π_i is the rate of return of capital.

From the profit maximization problem, and assuming that the number of varieties is large enough, we obtain the producer price in region i for any given variety:

$$pT^i = a\frac{\sigma}{\sigma - 1} w_i. \tag{9}$$

Additionally, the assumption of free entry and exit of firms means that in equilibrium firms obtain zero profits ($pT^i x_i - a w_i x_i - \pi_i F = 0$), such that the scale of production of each manufacture variety produced in region i is equal to:

$$x_i = \frac{\pi_i F(\sigma - 1)}{a w_i}. \tag{10}$$

By choice of units, we can assume $a = (\sigma - 1)/\sigma$ and $F = 1$, such that we get:

$$pT^i = w_i, \tag{11}$$

$$x_i = \frac{\pi_i \sigma}{w_i}. \tag{12}$$

Capital rent and total income

In the manufacturing sector, fixed costs are explained only by capital; its rent is the Ricardian surplus of a typical variety – that is, operating profits. Under Dixit–Stiglitz competition, these are equal to a fixed proportion of total sales (valued at producer prices), $pT^i x_i/\sigma$. By the assumption of free entry and exit, total operating profits for each firm must equal its cost of capital, $\pi_i F = pT^i x_i/\sigma$, and total capital reward must be equal to $\beta_M E^W/\sigma$. We assume that the federal government taxes all capital income,[17] and redistributes its proceeds between the two regions.[18] Then, total income in each region is the sum of labour income and transfers from the government. Let $0 < e_i < 1$ be the proportion of transfers going to region i; of these transfers, a proportion $0 < \phi < 1$ goes directly to consumers and $0 < (1 - \phi) < 1$ goes to the regional government, which uses these transfers to finance public employment. Transfers going to all consumers are equal to $\phi\beta_M E^W/\sigma$, such that the country's total income is:

$$E^W = \frac{(w_i L_i + w_j L_j)\sigma}{\sigma - \beta_M \phi}. \tag{13}$$

Incomes (and expenditures) in regions i and j are:

$$\begin{aligned} E_i &= w_i L_i + e_i \phi \frac{\beta_M E^W}{\sigma}, \\ E_j &= w_j L_j + (1 - e_i)\phi \frac{\beta_M E^W}{\sigma}. \end{aligned} \tag{14}$$

Regional governments

Regional governments receive their income from transfers from the federal government, which are financed with a tax on capital rewards. A proportion e_i of transfers goes to region i and $(1 - e_i)$ to region j. Since only a fraction $(1 - \phi)$ goes to the regional government, government budgets are in equilibrium when:

$$\begin{aligned} \frac{e_i(1 - \phi)\beta_M E^W}{\sigma} &= LG_i w_i, \\ \frac{(1 - e_i)(1 - \phi)\beta_M E^W}{\sigma} &= LG_j w_j, \end{aligned} \tag{15}$$

where LG_i and LG_j are the numbers of public employees in regions i and j.

The assumption that regional governments use revenues only to increase public employment is justified for three reasons. Firstly, assuming that regional governments use transfers to hire labour introduces a competition to the private sector through two channels: via direct competition for a scarce resource, and via the wage paid by the public sector, which in equilibrium must equal that of the private sector. Secondly, to avoid introducing a bias in consumption patterns, which would otherwise arise if regional governments had a different consumption pattern from that of consumers in the region. Alternatively, if consumption patterns were similar and as long as the share of manufactures consumption is important enough, a redistribution of transfers from region i to j would favour a relocation of manufacturing production towards region j due to the so-called home market effect (Fujita et al., 2001; Crozet and Trionfetti, 2008; Jianyong and Qiangqiang, 2010). In either case, the final result would be highly influenced by the consumption patterns of the public sector. Finally, the assumption is useful for looking at countries with low levels of accountability in the public sector where there is a strong tendency to use public resources for political gains. Argentina and most Latin-American countries are suitable examples of that behaviour.

Transfers and the long-run equilibrium

Using the following normalizations $F = 1$, $K = 1$, $L_i + L_j = 1$, $a = (\sigma - 1)/\sigma$, and choosing the wage rate in region i as *numeraire* ($w_i = 1$), operating profits reduce to:

$$\begin{aligned} \pi_i &= \left[\frac{\delta_i}{k_i + (1-k_i)(\tau w_j)^{1-\sigma}} + \frac{\tau^{1-\sigma}(1-\delta_i)}{k_i\tau^{1-\sigma} + (1-k_i)w_j^{1-\sigma}}\right]\frac{\beta_M E^W}{\sigma}, \\ \pi_j &= w_j^{1-\sigma}\left[\frac{\tau^{1-\sigma}\delta_i}{k_i + (1-k_i)(\tau w_j)^{1-\sigma}} + \frac{(1-\delta_i)}{k_i\tau^{1-\sigma} + (1-k_i)w_j^{1-\sigma}}\right]\frac{\beta_M E^W}{\sigma}, \end{aligned} \tag{16}$$

where $\delta_i = (s_{Li}(\sigma - \beta_M\phi))/((s_{Li} + (1 - s_{Li})w_j)\sigma) + e_i\beta_M\phi/\sigma$ is the share of region i in total income E^W, $s_{Li} = L_1/(L_1 + L_2)$ is the share of region i in total population and total income is equal to $E^W = (s_{Li} + (1 - s_{Li})w_j)$ $(\sigma/(\sigma - \beta_M\phi))$.

In the long-run equilibrium, we can have:

$$k_i = \begin{cases} 0 & \text{if } \pi_i < \pi_j, \\ 0 < k_i < 1 & \text{if } \pi_i = \pi_j, \\ 1 & \text{if } \pi_i > \pi_j. \end{cases} \tag{17}$$

Finally, if in the short-run $\pi_i \neq \pi_j$, we assume the relocation of capital is governed by:

$$\frac{dk_i}{dt} = f(\pi_i - \pi_j) \quad \text{with} \frac{\partial f}{\partial(\pi_i - \pi_j)} > 0. \tag{18}$$

From the two expressions in (16), changes in the regional distribution of transfers affect wage rates and capital rewards. Moreover, as capital moves between regions, it also affects the equilibrium wage rates; this circularity precludes closed-form solutions.[19] Because of this, the analysis in the next section is based on numerical simulations.[20]

Numerical simulations

In this section, we compare long-run equilibria following changes in the distribution of transfers between the regions. We do not analyse transition paths, although we examine the stability of the internal and core–periphery (CP) equilibria. The methodology to run our numerical simulations is quite general. Firstly, we define the ranges for the parameters; then, we make some parameters constant while using alternative values of the varying parameters to construct a uniform multidimensional grid. The domains over which the parameters are allowed to vary are:[21]

$$\begin{aligned} \beta_M &= (0,\ 1), \\ \phi &= (0,\ 1), \\ e_1 &= (0,\ 1), \\ \sigma &= (1,\ 10], \\ \tau &= (1,\ 10]. \end{aligned}$$

The way we build the combinations of parameter values means that within the pre-established ranges, the numerical simulation analysis renders our results pretty general.

Existence and stability of the internal and CP equilibria

We look at the set of parameter values for which an internal equilibrium ($\pi_i = \pi_j$), with both regions having positive shares of manufactures ($0 < k_i < 1$), emerges, *vis-à-vis* the case of a CP outcome ($k_i = 0$ or $k_i = 1$).

Figure 3 shows the results of 27 combinations of parameter values: low, intermediate and high σ and τ values combined with three alternative values of e_1. We keep β_M and ϕ equal to 0.5. These play only a minor role in the properties of the equilibrium.[22]

When $e_1 = 0.5$, there is one long-run equilibrium with $k_1 = 0.5$ and the model is globally stable. If $k_1 \neq 0.5$ in the short run, the return on capital is

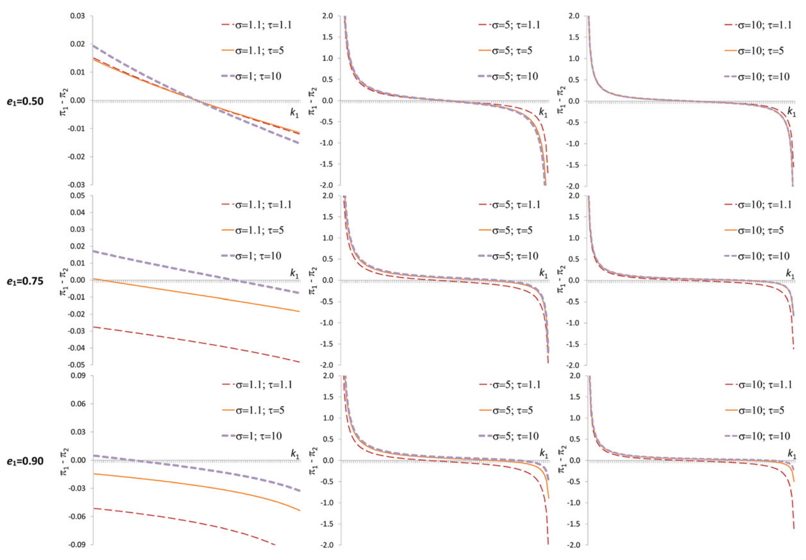

Figure 3. Stability of the internal and CP equilibria.

higher in the region with the lower capital stock, and firms in the other region will find it profitable to migrate.[23]

When $e_1 \neq 0.5$, if an asymmetric internal equilibrium exists, it is always stable. However, it is possible to find configurations of parameter values such that a stable CP equilibrium emerges, for which capital returns are not equalized. This is more likely for low values of σ and τ to a lesser extent. β_M and ϕ are less important in the distribution of K, as well as the impact the distribution of transfers has on the latter.

The region with the larger share of transfers never concentrates all the manufacturing production, so the CP equilibrium arises only when the relationship between the distributions of transfers and capital is negative. This result highlights the role of non-tradable goods and local governments: higher demands for production factors may cause that an increase in market size affects negatively the production of footloose activities, even to the point of reversing the home market effect, one of the most distinctive characteristics of most models belonging to the NGE family. Finally, unlike with other NGE models, we did not find the existence of multiple internal equilibria.

The long-run effects of a relocation of transfers

Since we know that a symmetric equilibrium always arises when $e_1 = 0.5$, we now look at the sets of parameter values which mean a positive or a negative effect on the share of manufactures for the region receiving an increase in federal transfers. Our main interest lies in the impact of the distribution of transfers on the location of manufacturing production – that is, the distribution of the stock of capital. From Equation (16) it is clear that in the long run, the distribution of capital depends on the distribution of transfers (e_i), but the direction and size of the effect are a function of four parameters: the elasticity of substitution (σ), the share consumers spend in manufactures (β_M), the share of transfers going directly to consumers (ϕ) and transaction costs (τ).

Again, we use numerical simulations looking to identify the conditions determining the relationship between the distribution of transfers and the long-run distribution of K. We give each of the four parameters, one at a time, four alternative values within its defined range and solve the long-run distribution of capital as we change the distribution of transfers (using 21 alternative values of e_1). Then, for each pair of e_1 and the parameter of interest, we construct a uniform 3-dimensional grid using 30 alternative values for each of the remaining 3 parameters, which yields a total of 27,000 simulations; this amounts to using 567,000 simulations for each of the 4 graphs in Figures 4–7.

For instance, let us consider the top-left panel in Figure 4. For a value of $\tau =$ 1.1 and for each of the 21 alternative values of e_1, we obtain the share of region 1 in the distribution of K for each of the 27,000 combinations of σ, ϕ

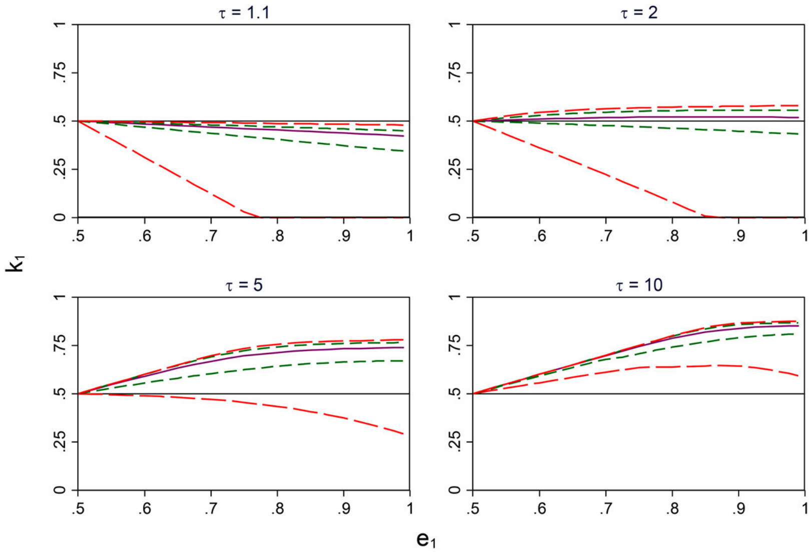

Figure 4. Distribution of K as a function of e_1 and τ.

Note: in each graph, for a given pair of e_1 and τ, we report the 5th, 25th, 50th, 75th and 95th percentiles of k_1 obtained from the combinations with a uniform 3-dimensional grid of σ, ϕ and β_M. The number of simulations for each pair of e_1 and τ is 27,000.

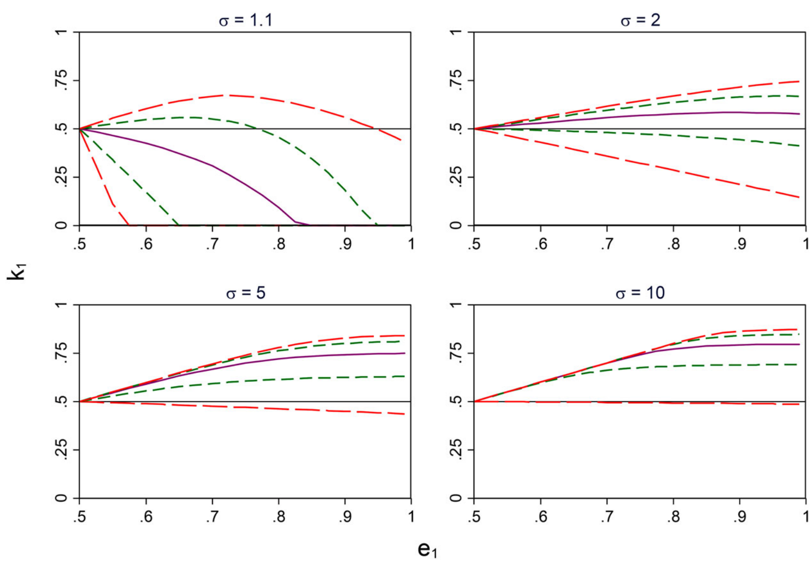

Figure 5. Distribution of K as a function of e_1 and σ.

Note: in each graph, for a given pair of e_1 and σ, we report the 5th, 25th, 50th, 75th and 95th percentiles of k_1 obtained from the combinations with a uniform 3-dimensional grid of τ, ϕ and β_M. The number of simulations for each pair of e_1 and σ is 27,000.

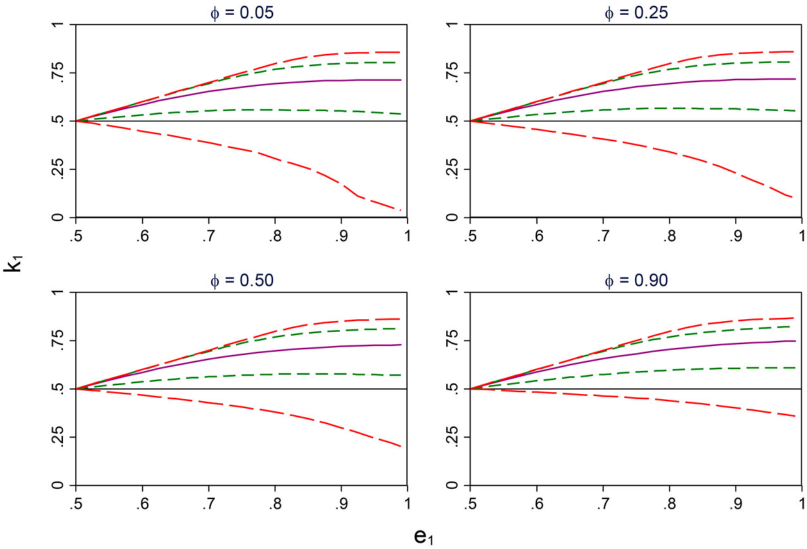

Figure 6. Distribution of K as a function of e_1 and ϕ.

Note: in each graph, for a given pair of e_1 and ϕ, we report the 5th, 25th, 50th, 75th and 95th percentiles of k_1 obtained from the combinations with a uniform 3-dimensional grid of τ, σ and β_M. The number of simulations for each pair of e_1 and ϕ is 27,000.

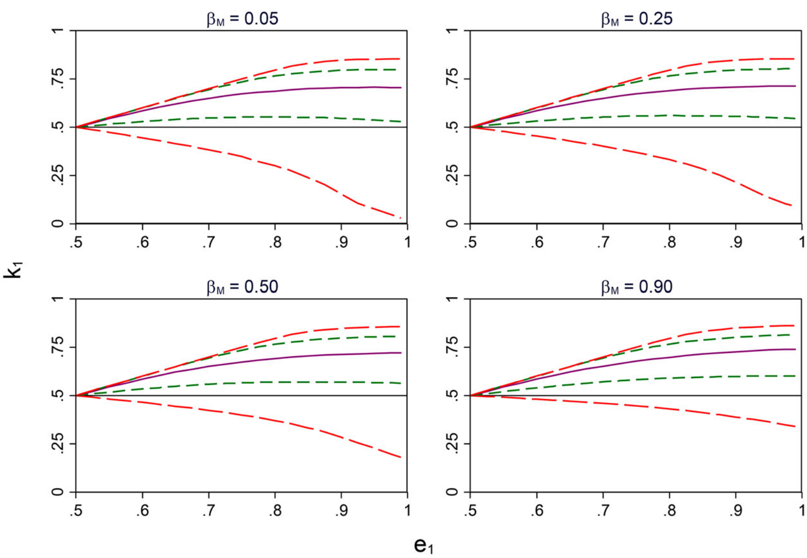

Figure 7. Distribution of K as a function of e_1 and β_M.

Note: in each graph, for a given pair of e_1 and β_M, we report the 5th, 25th, 50th, 75th and 95th percentiles of k_1 obtained from the combinations with a uniform 3-dimensional grid of τ, σ and ϕ. The number of simulations for each pair of e_1 and β_M is 27,000.

and τ. The vertical axis reports the values of k_1 corresponding to the 5th, 25th, 50th, 75th and 95th percentiles. The purple solid line is the median value of all simulations, the lower and upper red long-dash lines are the 5th and 95th percentiles, respectively, while the lower and upper green short-dash lines are the 25th and 75th percentiles, respectively. We provide similar graphs for the other parameters, σ (Figure 5), ϕ (Figure 6) and β_M (Figure 7).

The first result is that, starting from a symmetric distribution of transfers – $k_1 = 0.5$ with independence of the other parameter values – the larger the increase in the share of transfers, the larger the probability that there will be a disincentive to migrate manufacturing production to that region. However, this result is quite sensitive depending on the specific parameter we concentrate the analysis on. When σ and τ assume low values, an increase in the share of transfers is mostly associated with a lower share in the distribution of capital. This is most notably the case for $\tau = 1.1$ and $\tau = 2$ and $\sigma = 1.1$. The outcome is completely reversed when σ and τ are large enough.

On the other hand, when we look at the influence of ϕ (Figure 6) and β_M (Figure 7), most of the simulations imply that a level of $e_1 > 0.5$ is associated with a level of k_1 also larger than 0.5, with at least 75% of the simulated results belonging to this scenario. This is more likely the larger are β_M and ϕ.[24]

These figures give a pretty clear idea of how changes in the distribution of transfers are associated with the distribution of capital; large values of τ, σ, ϕ and β_M make more likely that the region with the larger share of transfers concentrates a larger share of capital. However, this is only a partial picture, since we do not provide the full distribution of k_1. In Figures 8–11 we show the full distribution of k_1; we do this by fixing the level of e_1 to 0.75 (a relatively asymmetric distribution) and by running 1,000,000 simulations using a uniform 3-dimensional grid combining the other 3 parameters (for each of the three varying parameters, we assume 100 alternative values). In Figures 8 and 9, we see that low values of τ and σ are associated with a high probability that k_1 is less than 0.5; if we start from a symmetric equilibrium, where $e_1 = k_1 = 0.5$ holds, the region receiving the higher share of transfers will end up experiencing a loss in its capital share. The opposite is true when both parameters are large enough. However, for ϕ (Figure 10) and β_M (Figure 11), most of the distribution of k_1 falls to the right of 0.5, such that as region 1 goes from an equal share of transfers to more than a half, it also happens with its share of capital.[25]

Out of the four parameters, τ, σ, ϕ and β_M, the first two have a more substantial effect on the probability that, starting from the symmetric equilibrium, an increase in the share of transfers a region receives would mean a reduction in its share of K. In this context, we can now fix the values of ϕ and β_M to 0.5, and use three values of e_1 (0.55, 0.75 and 0.95) combined with a uniform 2-dimensional grid of τ and σ (for each parameter, we assume 50 possible values so that the number of simulations is 2500 for each e_1). The top three

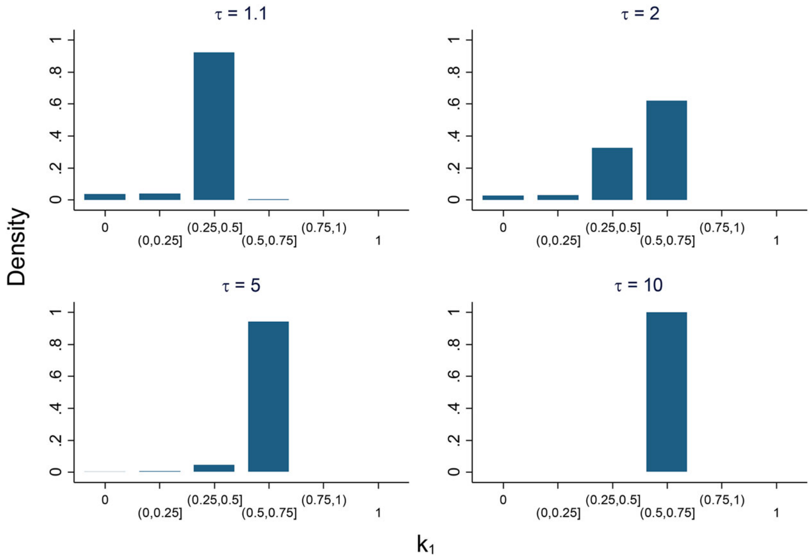

Figure 8. Distribution of K as a function of τ and $e_1 = 0.75$.

Note: in each graph, the values of k_1 are obtained by using a uniform 3-dimensional grid of the other three parameters (σ, ϕ and β_M). The number of simulations in each graph is 1,000,000.

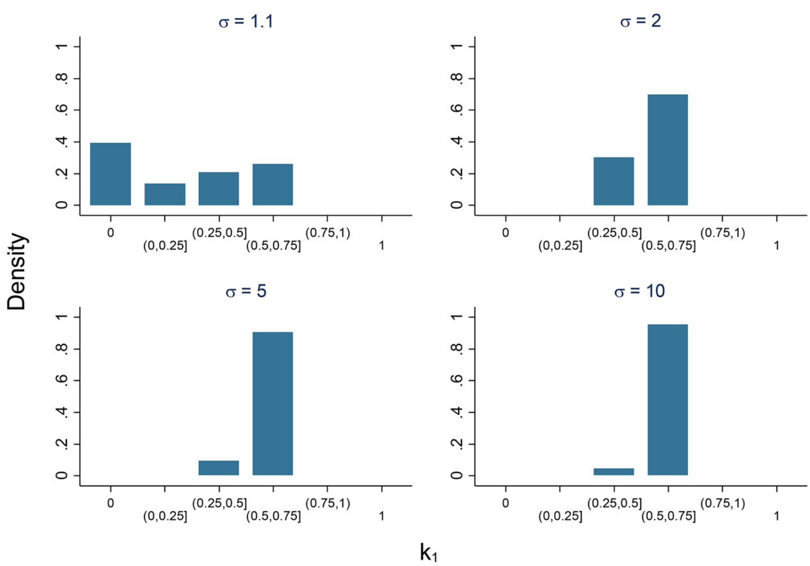

Figure 9. Distribution of K as a function of σ and $e_1 = 0.75$.

Note: in each graph, the values of k_1 are obtained by using a uniform 3-dimensional grid of the other three parameters (τ, ϕ and β_M). The number of simulations in each graph is 1,000,000.

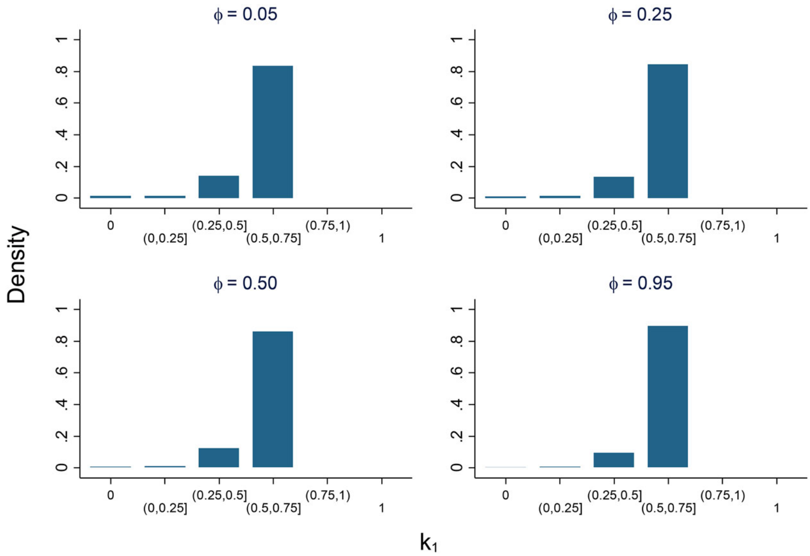

Figure 10. Distribution of K as a function of ϕ and $e_1 = 0.75$.

Note: in each graph, the values of k_1 are obtained by using a uniform 3-dimensional grid of the other three parameters (τ, σ and β_M). The number of simulations in each graph is 1,000,000.

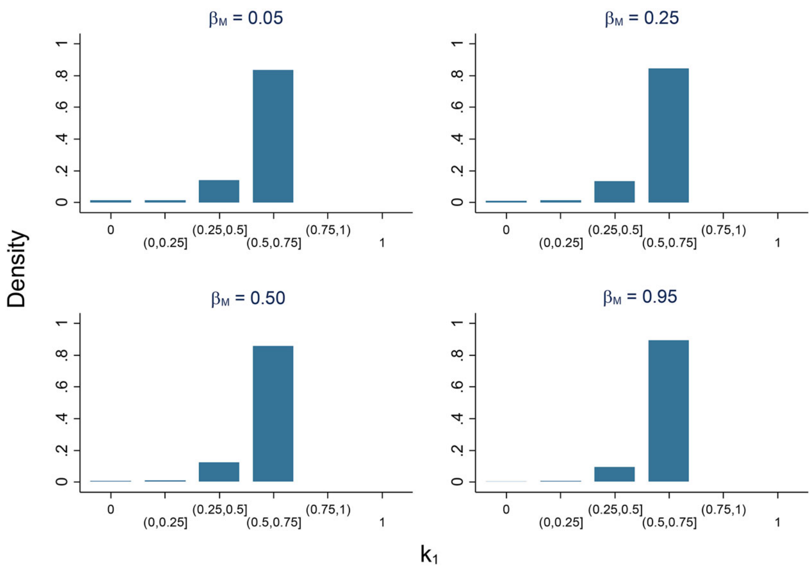

Figure 11. Distribution of K as a function of β_M and $e_1 = 0.75$.

Note: in each graph, the values of k_1 are obtained by using a uniform 3-dimensional grid of the other three parameters (τ, σ and ϕ). The number of simulations in each graph is 1,000,000.

graphs in Figure 12 clearly show that for low values of τ and σ (both below 3), an increase in e_1, from a value of $e_1 = 0.5$, means that region 1 reduces its share in the manufacturing sector; the size of the loss increases with the size of the change in e_1.

The bottom graphs in Figure 12 report the level curves showing the combinations of σ and τ such that $k_1 = 0.5$. Above and to the right of the level curves, $k_1 > 0.5$, while below and to the left the long-run equilibrium means $k_1 < 0.5$. The results shows that the higher e_1 is, the more likely that an increase from $e_1 = 0.5$ would produce a reduction in k_1. This is mostly due to an increase in the range of τ, for which $k_1 < 0.5$ is an equilibrium.

The economic rationale behind our results can intuitively be summarized as follows:

(a) *Elasticity of substitution* (σ): A larger elasticity of substitution means that consumers care less about the number of varieties, so they tend to consume more domestically produced varieties in order to save on transportation costs. Thus, as region *i*'s share of transfers (e_i) rises, the extra income is mostly spent on locally produced varieties, which increases firms' profits and so attracts new ones. Conversely, when σ is low, consumers tend to buy similar quantities of each variety regardless of where it was produced. In order to reduce the increased competition of the public sector for labour, some firms in the region receiving the higher transfer share relocate elsewhere without risking losing a great deal of sales.

(b) *Transaction costs* (τ): the larger the transaction costs are, the more consumers tend to spend on domestically produced varieties. Therefore, as a region's transfer income rises, the larger demand for locally produced varieties increases the profits of local firms, attracting those located in the other region.

(c) *Distribution of expenditure between manufactures and the non-traded good* (β_M): a rise in the share of income spent on manufactures *vis-à-vis* the non-traded good means that a larger share of transfer income would be also spent on manufactures *vis-à-vis* the non-traded good. Again, a higher demand for manufactures in the favoured region raises returns, attracting firms from the other region.

(d) *Share of transfers directly going to consumers* (ϕ): If $\phi = 0$, transfers increase the consumption of manufactures only indirectly, through wages paid by the regional government. However, when ϕ is positive, part of the transfers – that which goes to consumers – impact directly on the consumption of manufactures without labour moving from the private to the public sector. The demand effect is larger in this second case ($\phi > 0$), making more likely that firms find it profitable to relocate to the region which benefits from higher transfers.

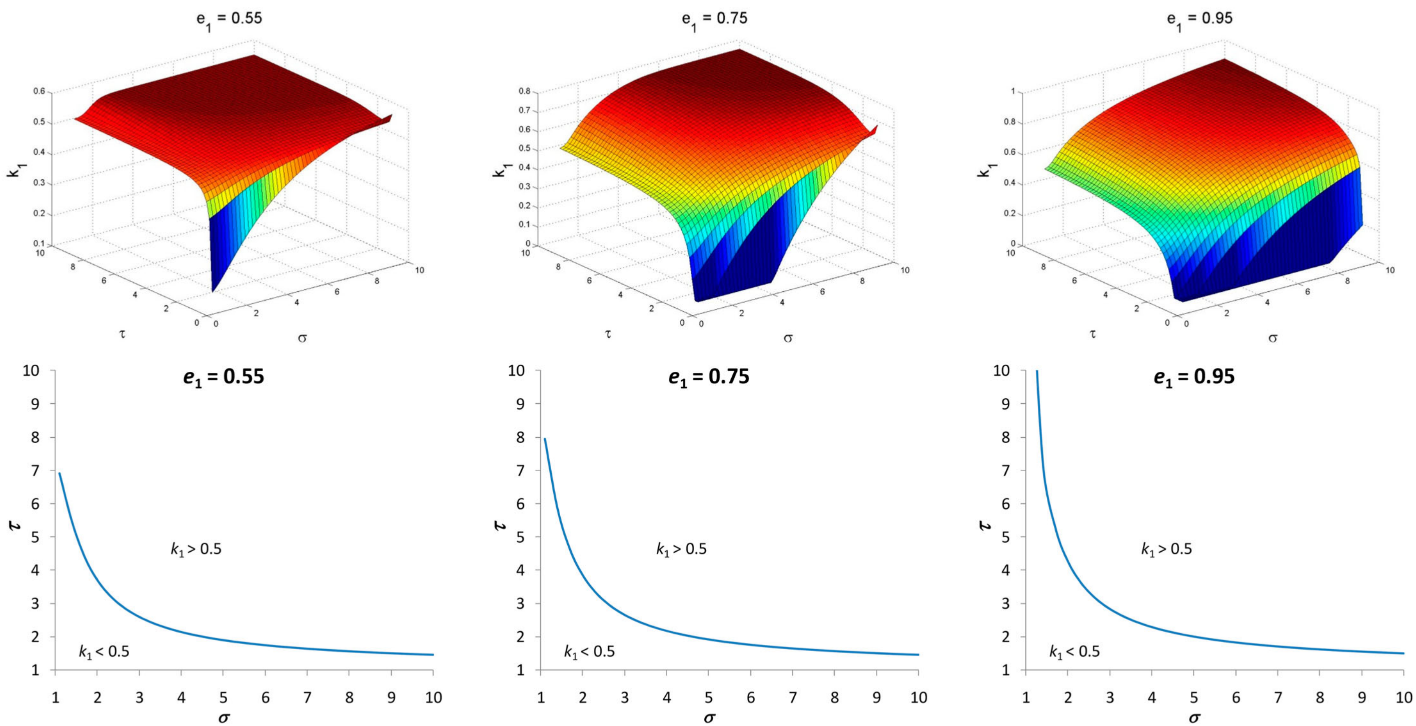

Figure 12. Long-run distribution of K as a function of τ and σ.

Note: in all cases $\phi = \beta_M = 0.5$. In the three upper graphs, the k_1 are obtained using the combinations of a uniform 2-dimensional grid with 50 alternative values of τ and σ.

An interesting result arising from the simulations is that whenever transfers are unequally distributed between the two regions, the distribution of transfers is always more concentrated than that of capital, with the latter being equal to the relative contribution each region makes to the nationally collected tax. Remember that transfers are financed exclusively with a tax on operating profits, and tax rates are equal across regions. The relative tax contributions are given by $K_i\pi_i/(K_i\pi_i + K_j\pi_j) = k_i$ and $K_j\pi_j/(K_i\pi_i + K_j\pi_j) = 1 - k_i$ for regions *i* and *j*, since in the long run, when both regions have a positive production of manufactures, the capital rate of return is the same across the regions: $\pi_i = \pi_j$.[26]

This result means that when a region receives more than 50% of transfers, its participation in the share of manufacturing production is larger than 50% if transfers favour the location of firms in the region, or less than 50% if transfers discourage the location of firms. However, the share of manufacturing production is always lower than its share of transfers. In this way, the region that receives more than half of transfers is a net recipient, while the other region is a net contributor. The amount each region has in terms of its position as a net recipient or a net contributor is larger when transfers discourage the location of firms in the region receiving higher transfers. The difference between transfers (including those given to consumers) and the contribution to its financing is equal to the negative of the balance of trade of manufactures. Thus, the region with the larger share of transfers has always a negative trade balance, which is financed with the transfers it receives from the federal government.

Two issues we have not dealt with are to what extent our results may be affected if labour is mobile and the type of firms that could be expected to migrate first. The assumption that labour is not mobile between regions means that the larger demand following from an increase in transfers results in greater competition for labour, from both the public and non-tradable sectors. For certain parameter values, this effect is such that manufacturing firms find it profitable to relocate to the region losing participation in transfers from the federal government. With mobile labour, it would become more likely that manufacturing firms would relocate to the region receiving an increase in transfers. The second issue (relocation by type of firm) would require using a model with heterogeneous firms. Baldwin and Okubo (2006) show using a model *à la* Melitz that the standard assumption of identical firms is neither necessary nor innocuous, with more productive firms moving first when there are relocation costs.

Finally, another extension that we leave for future research is related to the literature of the political economy of transfers, with heterogeneous regional governments in terms of their utility functions (e.g. preference for private production versus public employment).

Transfers and the regional location of manufactures: some stylized evidence for Argentina

A brief review of Argentina's transfer system

Argentina is a federal country with three overlapping levels of government: federal level (1 unit), regional level (24 units known as 'provinces') and local level (2259 units).[27] The top two levels coordinate their financial relations through the so-called *Régimen de Co-Participación Impositiva*, which is a tax-sharing scheme between the federal and provincial governments. All taxes not collected by the provincial governments add up to the tax pool,[28] which is then divided between the federal and provincial governments according to shares fixed by law. The funds received by the provincial governments are considered automatic transfers; they are legally established and not sensitive to political considerations. The federal government also grants discretionary, non-automatic transfers to the provincial, and also to the local, governments, which are given due to extraordinary circumstances, and, more often than not, political ones.

Provinces are the second most important level of government accounting for nearly 40% of total consolidated public spending.[29] Although legally entitled to receive around 56% of the tax pool, they are receiving less than 30% in recent years.[30] This results in a large vertical fiscal imbalance and the need for more non-automatic transfers (and bailouts) which are discretionarily given by the federal government in exchange for political support. These transfers, in addition to becoming relatively more important, showed a strong variability, representing about 3.4% of total current revenues in 1983 and 4.85% in 2005. Provinces have limited autonomy to conduct tax policy: there are only a few state-level taxes – sales and property tax – that provinces can rely on for raising revenues. Since these are only a small fraction of total revenues, provinces can do very little in terms of attracting firms by lowering taxes.

Argentine provinces are quite heterogeneous in terms of population and GDP levels. The 4 largest provinces represented over 66.4% of the population in 1983 and 61.5% in 2005, while the 4 smallest provinces only represented 1.9% in 1983 and 2.7% in 2005. Similarly, the 4 largest provinces accounted for 75% of total GDP in 1983 (just below 72% in 2005),[31] while the smallest accounted for 2.33% of total GDP in 1983 (3.15% in 2005). Even more striking, the 4 largest provinces accounted for 82.9% of manufacturing GDP in 1983 (77.8% in 2005), with the 4 smallest contributing only 0.73% in 1983 (and just below 0.7% in 2005).[32] Furthermore, the share of own-source revenues (relative to total revenues) of the largest provinces is three times larger.

Provinces are also heavily dependent on transfers from the national government. Between 1983 and 2005, almost all the provinces (19 out of 24) have increased their dependence from the federal government;[33] the ratio of transfers to provinces' total current expenditure has increased between 6% and 72% for different provinces. Small and medium-sized provinces have increased their dependence more than the larger ones; however, there is still a great heterogeneity. Clearly, smaller and poorer provinces rely much more on transfers from the federal government than do large provinces. Because of this heavy dependence on transfers from the federal government, provinces even when having the power to pursue their own industrial policies have historically not followed that path, maybe with exceptions to some specific sectors and during a very limited period of time.

Empirical evidence

Based on the intuition from the theoretical model, we now provide some empirical evidence related to the role of top-down intergovernmental transfers on the distribution of manufacturing production across Argentine provinces. In particular, we look at whether the distribution of transfers between provinces is related to the distribution of manufacturing production.[34] The theoretical model in the third section is ambiguous concerning how changes in the regional distribution of federal transfers to the provinces may affect the regional distribution of manufacturing production; in fact, the sign and size of this relationship are a function of four parameters, with higher values of them favouring the concentration of manufacturing production in regions that benefit from an increase in transfers. Because of the lack of appropriate data, we do not intend to test the model structurally, but instead estimate a reduced form. The analysis covers the period 1983–2005 for an unbalanced panel of 23 provinces plus the City of Buenos Aires.[35] The baseline equation we estimate is the following:

$$gdp_{jt} = \alpha_0 + \alpha_1 \text{transfers}_{jt} + \beta_j (d_j \times T) + \eta_j + \varepsilon_{jt}, \tag{19}$$

where $gdp_{jt} = ((\text{GDP}_{jt}/\sum_j \text{GDP}_{jt}) - (\text{POP}_{jt}/\sum_j \text{POP}_{jt})) \times 100$ is the share of province j at time t in the country's manufacturing GDP, normalized by the share in population (POP); $\text{transfers}_{jt} = ((\text{TRANSFERS}_{jt}/\sum_j \text{TRANSFER } S_{jt}) - (\text{POP}_{jt}/\sum_j \text{POP}_{jt})) \times 100$ is the share of province j at time t in total federal transfers to the provinces, normalized by the share in population; d_j is a dummy variable for province j; T is a linear trend; η_j is an idiosyncratic effect of province j and ε_{jt} is an error term.

The reason to normalize the shares in GDP and TRANSFERS is to account for the fact that unlike our theoretical model and as noted in the previous subsection, there are important asymmetries among Argentinean provinces. Additionally, normalization controls for changes in the distribution of the population that may have occurred during the period 1983–2005.[36] The inclusion of a linear trend specific to each province allows us to control for other factors that may have played a role in the different evolution of the dependent variable for each province.[37]

We use three different measures of transfers: (1) total transfers (excluding capital transfers), (2) tax transfers (*Régimen de Co-Participación Impositiva*) and (3) current transfers (tied and untied over which the federal government has discretionary power).

We also use a variable to account for the political alignment (AP) of the provincial governments with the federal administration. This variable is used independently or interacted with current transfers, which are the ones the federal government has discretionary power to assign them between provinces.[38]

Tables 1 and 2 present regression models using annual and moving average observations, respectively. In both tables, we present the results from different specifications using a fixed effect (FE) estimator (columns 1–5), robust regressions (RR) that deal with the presence of outliers (columns 6–10) and a mixture model (MM) to allow for the possible existence of different regimes.

Looking at the results from annual data (see Table 1), most coefficients are not statistically significant when using a FE estimator. When controlling for the possible presence of outliers, total transfers are positively and significantly related to the distribution of manufacturing GDP. Tax transfers are positive and significant in one out of three cases, while current transfers have a negative coefficient. Such cases are those when the political alignment variable is not interacted with current transfers. Interestingly, political alignment is always positive, and significant in two of the three cases; the same results hold when interacted with current transfers.

An interesting pattern emerging from the RR models is that most of the observations identified as outliers, and so carrying a lower weight in the estimations, belong to a limited number of provinces – namely, large and rich provinces located mostly on the centre-east of the country.[39] Because of this, it is possible that the FE estimator is not biased because of outliers, but rather due to the existence of different regimes.

To explore this possibility, we run a finite MM for the case of panel data with FEs (Deb and Trivedi, 2012), and assign each province to the group to which more than a half of its observations belong to. Then we estimate a FE model separately for each regime. The results for the provinces belonging to regime 1 (small and low-income provinces), which is composed of those carrying most of the weight in the RR estimates, are, not surprisingly, very similar to the RR results in terms of signs and statistical significance. For regime 2, instead, the estimates are not significant.

The use of annual data has the potential drawback of being subject to short-run shocks, when the phenomenon we want to study is more of a long-run nature. Thus, we resort to use five-year moving averages,[40] which,

Table 1. Dependent variable: distribution of manufacturing GDP (annual data).

	Fixed effects					Robust regressions				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Total transfers	−0.0075	−0.0127				0.0690***	0.0579***			
	(0.047)	(0.045)				(0.008)	(0.017)			
Tax transfers			−0.0065	−0.0089	−0.0070			0.0360	0.0463**	0.0349
			(0.043)	(0.040)	(0.043)			(0.139)	(0.019)	(0.032)
Current transfers			0.0173*	0.0136	0.0182			−0.0071	−0.0069***	0.0000
			(0.010)	(0.010)	(0.016)			(0.070)	(0.002)	(0.002)
Political alignment (AP)		0.1596		0.1449			0.0044		0.0430**	
		(0.110)		(0.111)			(0.016)		(0.017)	
PA × Current transfers					−0.0014					0.0137***
					(0.011)					(0.001)
Observations	519	519	519	519	519	519	519	519	519	519
R^2	0.398	0.410	0.404	0.414	0.404					

	Mixed models									
	Regime 1					Regime 2				
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
Total transfers	0.0694	0.0667				−0.0317	−0.0423			
	(0.048)	(0.043)				(0.067)	(0.063)			
Tax transfers			0.0407	0.0407	0.0391			−0.0159	−0.0211	−0.0222
			(0.034)	(0.034)	(0.033)			(0.065)	(0.052)	(0.062)
Current transfers			0.0155***	0.0147**	0.0008			0.0180	0.0101	0.0209
			(0.005)	(0.005)	(0.009)			(0.023)	(0.025)	(0.025)
Political Alignment (AP)		0.0369		0.0235			0.5514		0.5360	
		(0.052)		(0.051)			(0.372)		(0.381)	
PA × Current transfers					0.0160**					−0.0078
					(0.007)					(0.008)
Observations	369	369	369	369	369	150	150	150	150	150
R^2	0.320	0.327	0.351	0.353	0.372	0.406	0.443	0.409	0.443	0.410
# Provinces	17	17	17	17	17	7	7	7	7	7

Note: Robust standard errors in parentheses. All regressions include province fixed effects and province-specific time trends.
*** $p < .01$.
** $p < .05$.
* $p < .1$.

Table 2. Dependent variable: distribution of manufacturing GDP (five-year moving average).

	Fixed effects					Robust regressions				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Total transfers	−0.2181**	−0.2357***				0.0470	0.0376			
	(0.078)	(0.083)				(0.051)	(0.030)			
Tax transfers			−0.1892***	−0.2054***	−0.0787			0.1966***	0.0127	0.2108
			(0.057)	(0.062)	(0.072)			(0.046)	(0.017)	(0.136)
Current transfers			0.0037	0.0001	−0.0379			0.0120***	0.0099***	0.0065
			(0.018)	(0.018)	(0.027)			(0.002)	(0.003)	(0.007)
Political alignment (AP)		0.1278		0.1186			−0.0194**		−0.0239	
		(0.143)		(0.147)			(0.009)		(0.019)	
PA × Current transfers					0.0415**					0.0042
					(0.018)					(0.006)
Observations	423	423	423	423	423	423	423	423	423	423
R^2	0.671	0.679	0.666	0.672	0.689					

	Mixed models									
	Regime 1					Regime 2				
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
Total transfers	0.2362	0.2305				−0.2993***	−0.3518**			
	(0.149)	(0.148)				(0.056)	(0.108)			
Tax transfers			0.1751	0.1750	0.1825			−0.2926***	−0.3311**	−0.1772
			(0.163)	(0.164)	(0.165)			(0.066)	(0.121)	(0.117)
Current transfers			0.0190***	0.0189**	−0.0157			−0.0460	−0.0420	−0.0532
			(0.006)	(0.009)	(0.024)			(0.045)	(0.060)	(0.040)
Political alignment (AP)		0.0233		0.0033			0.4457		0.3931	
		(0.077)		(0.083)			(0.511)		(0.512)	
PA × Current transfers					0.0269					0.0299
					(0.016)					(0.026)
Observations	301	301	301	301	301	122	122	122	122	122
R^2	0.486	0.488	0.513	0.513	0.543	0.707	0.731	0.705	0.723	0.711
# Provinces	17	17	17	17	17	7	7	7	7	7

Note: Robust standard errors in parentheses. All regressions include province fixed effects and province-specific time trends.

*** $p < .01$.

** $p < .05$.

* $p < .1$.

in addition to smoothening the series, would better capture the long-run trends and be less affected by year-specific shocks.[41]

Even when Table 2 presents the same models as Table 1 does, but now using five-year moving averages instead of annual data, because of the likelihood of different regimes, we concentrate the discussion on this last case. For provinces belonging to regime 1, the results are in line with the previous ones, only that even when political alignment is still positive now it is not significant. For provinces in regime 2, the coefficients for all transfer variables are negative, while significant for total and tax transfers, in this last case when political alignment enters without interaction. As with regime 1, political alignment is positive but not significant in all cases.

Summarizing the results just described, it seems that in the case of the small and in most cases poorer provinces (those belonging to regime 1), transfers play, to some extent, a positive effect fostering the location of manufacturing production. On the other hand, no effect or even a negative one may be occurring for the larger and richer jurisdictions (those belonging to regime 2). A possible explanation for these results may be the large differences in terms of industrialization and development between small/poorer and larger/richer provinces. For provinces in regime 2, transfers from the federal government may not be as effective in increasing their share in manufacturing production, since they represent just a small fraction of their GDP; increasing their share of manufacturing production beyond their already high level may require of very large current transfers, and even in this case it may be less costly to use these transfers to hire public employment and raise public wages. In the case of the first group, in addition to being much less industrialized and with large public employment in per capita terms, these provinces are highly dependent on these transfers; so a small change may represent an important impact on their economies through a larger domestic demand.

Finally, even if the evidence is not conclusive, it looks like political alignment may yield a positive effect in terms of the participation on manufacturing production, especially for the small/poorer provinces. This effect appears to be operating through non-automatic transfers, those over which the federal government has a wide discretion to favour some jurisdictions (the politically aligned) at the expense of the others.

Summary and conclusions

Evidence on the transfer paradox is mixed at the international level and scarce at the subnational level. Most work focus on the political economy of transfer allocation, but few papers have looked at impacts on regional industrial development. This paper provides a theoretical analysis of this issue and advances some empirical results. The effect of intergovernmental transfers on regional manufacturing production is ambiguous. The size and direction depend on the simultaneous interaction of factors that are out of control of the public sector (e.g. consumer preferences), as well as other variables over which governments can influence on – amount and destination of transfers – and transaction costs. Thus, it also becomes an empirical matter what relationship, if any, there exists between top-down intergovernmental transfers and the location of footloose activities.

For Argentina during the period 1983–2005, the evidence is mixed. While in general it weakly supports that the regional distribution of manufacturing production is negatively related to the regional distribution of transfers, especially for the case of untied transfers, the results appear to be driven mostly by the behaviour of the larger/richer jurisdictions. When we distinguish between two regimes, smaller/poorer provinces on the one side and larger/richer on the other side, the former appears to benefit in terms of manufacturing production from an increase in transfers, while for the latter the effect is the opposite or at most is not significant. A possible explanation for this result may be rooted in the striking differences in terms of industrialization and development between the two groups. Also, for the smaller/poorer provinces, to be aligned with the federal government may be profitable as a means to foster industrialization through the receipt of discretionary transfers.

Finally, it is worth mentioning that our analysis has focused only on the role of transfers over which local governments have a rather tight control on how to use them – which in our model find their way through the demand side. However, other kinds of transfers that may have an important role in shaping the regional pattern of production are those that have an impact on the supply side. A good example of such transfers is subsidies to firms or capital transfers directed to the improvement of physical and human capital. The evidence for Argentina is even much less clear with regard to this type of transfers. These and other factors that cannot be controlled for explicitly, we hope, are captured by the province-specific time trends.

Notes

1. One of the reasons why vertical transfers are so common in many federal countries is due to the fact that often they are used as a device to introduce political conditionality upon the subnational governments.
2. Non-automatic transfers are also used to bail out regions facing extraordinary circumstances and short-term economic difficulties.
3. This is equivalent to a pure Dutch-disease-like effect, where increases in wages and prices of non-tradable relative to tradable goods cause an unambiguous fall in regional competitiveness. The original formulation of the Dutch disease proposes that a discovery of natural resources can have an overall positive impact on total income, but have a negative impact on production and incomes of the non-resource tradable sector through an appreciation of the real exchange rate.

4. This mechanism was first suggested by Hirschman (1958) several decades ago when he suggested that the transfer paradox could work through changes in relative prices, with foreign aid increasing the relative price of non-tradable goods because of the expansion of domestic demand.
5. In recent years, the Dutch disease literature has motivated at least partly the literature associated with the so-called political resource curse. This literature highlights adverse effects associated with windfall government revenues through the interaction among interest groups competing for rents (Robinson et al., 2006), through exacerbation of agency problems and through lower candidate quality (Lam and Wantchekon, 2002; Brollo et al., 2013; Caselli and Michaels, 2013).
6. Interestingly, they find that federal transfers have a negative effect on private wages paid to qualified workers.
7. In all figures, we use the same categories. Large and rich provinces are *Buenos Aires*, *Ciudad Autónoma de Buenos Aires* (CABA), *Córdoba*, *Santa Fe* and *Mendoza*. For the subnational democracy grouping, we used all the provinces in the lowest quintile in terms of subnational democracy: *Formosa*, *La Pampa*, *La Rioja*, *Santa Cruz* and *San Luis*. We also used an alternative classification due to Giraudy (2009), dividing provinces between patrimonial and bureaucratic. Patrimonial – that is, provinces where power is highly centralized and public resources are appropriated by the ruler – provinces are *La Rioja*, *Formosa*, *Tierra del Fuego*, *Neuquén* and *Santiago del Estero*. The results are qualitatively similar. Due to space constraints, they are not shown in the paper, but are available from the authors upon request.
8. Although we do not model political economy considerations explicitly, we address some of the theoretical and empirical insights given in these papers in the empirical model provided by including political alignment and the consideration of potential sub-regimes – that is, different clusters of provinces.
9. As opposed to transfers going to regional (state) governments.
10. We also depart from Martin and Rogers (1995) by not including an agricultural sector which produces under CRS using only labour a homogeneous good that is freely traded between regions. The inclusion of such sector simplifies greatly the model, but at the expense of breaking the ambiguity between the distribution of transfers and the distribution of manufacturing production, with a monotonously positive relationship between the two variables.
11. Because we are interested in studying the effects derived from a domestic policy, namely, changes in the distribution of transfers from a federal government to regional ones, we keep the model as simple as possible, and assume a closed economy. This assumption is innocuous to the analysis as long as the demand from the rest of the world can be assumed to be exogenous, which would be the case if the economy under study is a small one, which is a good approximation to the case of Argentina.
12. This assumption is made based on the literature on public finance, which suggests it is more efficient for the federal government, instead of regional level governments, to tax footloose activities or factors that are potentially mobile across regions. Some of the reasons for this is to avoid 'tax wars' between subnational levels of government, and avoid the possibilities of tax illusion by firms that operate in more than one region, which may have incentives to formally record their activities in those regions with lower tax rates. Additionally, this is the way the income tax currently works in Argentina.

13. Public employment can be also interpreted as a type of non-traded good.
14. Unless it is necessary to avoid confusion, in the presentation of the model we will refer only to region *i*, with similar expressions holding for region *j*.
15. Since there is no savings in the model, income is equal to expenditure.
16. For *N* large enough, σ is also the price elasticity of demand of each variety.
17. There would be no difference if we assume that the tax rate is less than 100%. In that case, we would need to make an assumption about how capital ownership is distributed between regions. Martin and Rogers (1995) assume that each unit of capital is evenly owned by each individual such that the regional distribution of capital has no effect on the demand for manufacturing goods and so neither on the location of capital.
18. With labour being immobile, there would be no change in the incentives to locate in each region as long as a uniform tax rate is applied in the two regions, other than the government would have more funds to distribute. For the sake simplicity, we assume labour income is not taxed.
19. This is similar to what happens in Krugman's CP model. The difference is that in Krugman's (1991) model, the circularity arises because consumers migrate in response to differences in real wages. The FCM of Martin and Rogers (1995) breaks this circularity because even when capital is mobile, the distribution across regions of operative profits is kept fixed, while wages are equal between regions as long as both regions have a positive production of the good traded without transaction costs, which is produced using only labour under CRS.
20. Because we are interested in looking at how changes in the distribution of transfers may affect the distribution of a given endowment of capital, we work with a static model in order to keep the analysis as simple as possible. This last assumption is innocuous to the analysis as long as the forces which determine capital accumulation, other than the distribution of transfers, are the same in both regions.
21. For β_M, ϕ and e_1 the ranges are the same as the theoretically possible. For ϕ the range (1,10] includes most of the estimates found in the empirical literature, especially the ones from international trade. Finally, the assumption τ can take a value up to 10 means that trade costs can be up to 900% of the producer price, a value high enough to cover most of the possible scenarios one could imagine. The number of points in the multidimensional grid varies depending on the case we look at. In all other aspects than the share in transfers each one receives, both regions are identical. Because of the symmetry of the model we limit the analysis to the case of region 1 and for $e_1 = [0.5,1)$.
22. In simulations not reported here, we allow also for varying values of β_M and ϕ, but the results do not change substantially. They are available from the authors upon request.
23. This is the result obtained by Martin and Rogers (1995).
24. Even when there are cases for which a larger participation in the transfers from the federal government is associated with a low share of *K*.
25. In Appendix 2 (see Supplementary data), we report the results for the cases of $e_1 = 0.55$ and $e_1 = 0.95$. Even when the patterns of the results do not change, the larger the change in e_1, the more likely region 1 loses share in manufacturing production when it benefits with an increase in transfers starting from a symmetric distribution.

26. In the case of a CP equilibrium, the region concentrating all manufacturing production is the sole contributor to the tax revenues.
27. Although technically a local government, the CABA is often considered as another mid-level jurisdiction due to its fiscal and political autonomy and to the fact that it has political representation in the national Congress.
28. National and federal taxes, with the exception of import and export duties and taxes part of specific regimes, form part of the tax collection pool.
29. Local (municipal) governments represent only a small fraction of total consolidated public spending. Although total spending by these governments has been increasing in the last 10 years, it represents a minor fraction – around 7% – of total consolidated public spending.
30. Several channels help to explain these imbalances. Firstly, several important taxes are not part of the tax-sharing scheme – most importantly export and import tariffs and labour taxes, while many others are subject to significant deductions before adding up to the tax pool, and a few others which have a specific assignment. Secondly, over the last 30 years, several public services have been decentralized to the provinces, while the criteria and coefficients specified in the legal documents have not been modified to reflect the new situation.
31. Because of missing data in 2005, GDP figures exclude the provinces of *Corrientes, Misiones* and *Tierra del Fuego*. Sadly we do not have more recent and reliable data on provinces' GDP.
32. The provinces at the bottom of the ranking are not necessarily the same in both years, as well as when looking at total or manufacturing GDP. However, *Buenos Aires*, CABA, *Santa Fe* and *Córdoba* remain always in the top four places.
33. The provinces that have reduced their dependency are the ones located in the *Patagonia* region, and the CABA. For the first group, the main reason is they experienced an important increase in their own revenues, and so also in their capacity to increase expenditures, when the federal government recognized in the nineties an increase in the hydrocarbon royalties for the exploitation of the oil and gas resources located in their territories. However, for a long period already, some of these provinces, especially *Santa Cruz*, have benefited greatly by an increase in direct expenditures made by the federal government in their jurisdictions.
34. It is important to take into account that the analysis of this section does not imply any sort of convergence analysis.
35. *Corrientes*, *Misiones* and *Tierra del Fuego* are the provinces for which we have incomplete data.
36. We also tried using the share in total population as an additional regressor, instead of normalizing the variables, and the results were very similar. These are available from the authors upon request.
37. Sadly, Argentina's subnational data are quite scarce, and when available, it is pretty difficult to build up a database for a period of time long enough such as the one required for the topic we are interested in analysing. Thus, the use of the province-specific time trends constitutes at most a second best.
38. There are several ways to code the political alignment variable. Some authors suggest to use a party alignment variable where the regional and federal government are aligned if they had run and won under the same party name. Other authors suggest that this does not take into account

actual alignment which is best captured by executive coattails and legislative voting records. Since it is a common practice to run on different party names even when candidates belong to the same coalition, we opted to use a political alignment variable that captures this *de facto* coalitional dynamics.

39. *Buenos Aires*, CABA, *Córdoba*, *Entre Ríos* and *Santa Fe*. Two small provinces, *San Luis* and *Tierra del Fuego*, also belong to this group. A characteristic of these two provinces is that they benefited greatly, especially *San Luis*, from different industrial promotion schemes that were in place during the period here considered, which were intended for a small number of provinces.
40. Before constructing the ratios, we first calculate the averages of the variables that go into the numerator and denominator. For instance, for the case of the *gdp*, we have: $gdp_{j,T-4,T} = \left[\frac{\left(\sum_{t=T-4}^{T} \mathrm{GDP}_{jt}\right)/5}{\left(\sum_{t=T-4}^{T} \sum_{j} \mathrm{GDP}_{jt}\right)/5} - \frac{\left(\sum_{t=T-4}^{T} \mathrm{POP}_{jt}\right)/5}{\left(\sum_{t=T-4}^{T} \sum_{j} \mathrm{POP}_{jt}\right)/5} \right] \times 100.$
41. Alternatively, we could have used data in time intervals, or to disentangle from each series the permanent and transitory components, for instance through the filter of Hodrick–Prescott. However, in both cases, the time length of our data set is too short for following those approaches.

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