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Disentangling the distributive impact of fiscal policy

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DISENTANGLING THE DISTRIBUTIVE IMPACT OF FISCAL POLICY

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Abstract

This paper measures the distributive impact of fiscal policy on personal and regional income distribution and provides a decomposition of the redistributive effect of fiscal policy for individual income units and when they belong to groups. This methodology is useful to identify how much of redistributive effect and also progressive/regressive effects apply within groups, between groups and among overlapping units, and whether there are tensions between different effects. The execution of fiscal policy in Argentina for year 2010 is the case of study. Fiscal policy reduces income inequality under both personal and regional definitions. The vertical effect is strong and weakly compensated by reranking. The vertical effect is a net result of progressive expenditures and regressive taxes. The selection of groups displays particular results. The findings are relevant for the design of fiscal policy in federal countries that pursue both efficiency and equity goals. In the case of Argentina (and this certainly can be extended to other federal countries), this may include rebalancing expenditures among different kinds or levels of governments, as well as the re-designing the tax system and eliminating tradeoffs observed from the current context.

Keywords: Welfare Economics; Redistributive effect; Tax incidence; Expenditure benefits Measurement of Redistribution; Fiscal Policy.

JEL Codes: D63, H22, H23

Resumen

En este trabajo se mide el impacto distributivo de la política fiscal sobre la distribución personal y regional del ingreso y se descompone el efecto redistributivo para unidades individuales de ingreso y cuando estas unidades pertenecen a grupos. La metodología es útil para desagregar cuanto del efecto redistributivo y de los efectos progresividad/regresividad se originan dentro de cada grupo, entre grupos, y por superposición de unidades, y si existen tensiones entre los efectos que resultan de esas desagregaciones. La ejecución de la política fiscal Argentina en 2010 es el caso de estudio. La política fiscal reduce la desigualdad regional y personal del ingreso. El efecto vertical es fuerte y es compensado parcialmente por reranking. La selección de grupos da lugar a resultados particulares. Los hallazgos del trabajo son relevantes para el diseño de la política fiscal en países federales cuyos objetivos son la eficiencia y la equidad. En el caso argentino (que puede ser extendido a otros países federales) puede incluir el rebalanceo de gastos entre los distintos niveles de gobierno, así como el rediseño del sistema impositivo y la eliminación de los *tradeoffs* observados en el trabajo.

Palabras clave: economía del bienestar; efecto redistributivo; incidencia impositiva; beneficio de gastos; medidas de redistribución; política fiscal.

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1. Introduction

The redistributive effect of fiscal policy has gained attention since the paper by Musgrave and Thin (1948) almost seven decades ago. The contributions by Musgrave (1964), Reynolds and Smolensky (1977) and Kakwani (1977), among others, gave room to a research agenda that is still fruitful nowadays. Different papers proposed several approaches to measuring the effect of fiscal policy on income distribution. We identify four main contributions to the analysis of the redistributive effect: (i) the design of fiscal policy (size and progressiveness), (ii) the result of disentangling the effect by levels of government; (iii) the net effect of horizontal and vertical redistribution, and (iv) the effect of reranking on income redistribution.

The first two contributions correspond to a main concern of fiscal policy regarding its effect on income distribution, at least since the "welfare state" view of the theory of the state (Musgrave, 1996). Since then, one of the main recurring questions is the effect of consolidated fiscal policy, the effects by levels of government, as well as the individual effects of taxes and expenditures, on income distribution (Musgrave, 1964; Kakwani, 1977; Reynolds and Smolensky, 1977).

The third contribution focuses on the concern of fiscal policy about treating equals on an unequal fashion (horizontal equity) as well as redistributing income from high-income units to low-income units (vertical equity). As Feldstein (1976) puts it: "If two individuals would be equally well off (have the same utility level) in the absence of taxation, they should also be equally well off if there is a tax. More generally, the introduction of a tax should not alter the ordering of individuals by utility level". This is the ordinality principle.

Related to this concern, the third contribution has grounds on a fairness requirement that fiscal policy should not alter the ranking of income receivers along the income distribution (Feldstein, 1976; Atkinson, 1980; Plotnick, 1981). Along these lines, Deaton (1996) states that "...quasi-concavity implies that social welfare will be increased by any transfer of x from a richer to a poorer person, provided only that the transfer is not sufficiently large to reverse their relative positions. This is the 'principle of transfers'".

The fourth contribution is about reranking, which is important because it violates horizontal equity and weakens vertical equity. On another hand, both vertical and horizontal effects may have (different) ethic grounds based on welfare theory, while justifications for reranking are not straightforward. Notwithstanding, Schiller (1977), King (1983) and Wagstaff (2009) provide an alternative interpretation that reranking is a good result in that reflects mobility of income units. Wagstaff (2009), in particular, discusses this argument in a context of growth and income redistribution (and such interpretation could be difficult to argue in a context of execution of fiscal budgets).

In the theory and practice of fiscal federalism an important question is the relevant dimension of distribution. Should the aim of public policy be regional distribution, personal

distribution or both? Intergovernmental transfers (or more generally, tax sharing schemes) are targeted to intermediate levels of government (say, provinces), not to individuals. "The problem is that even relatively poor communities usually contain some wealthy persons, and, similarly, rich jurisdictions often have some poor residents. As a result, in some cases, the intergovernmental grants may well tend to exaggerate rather than reduce the existing degree of inequality in the distribution of income; some income will tend to move from persons of lower incomes to relatively wealthy individuals" (Oates,1972, p.31). Whether tax sharing regimes succeed or fail in this task can be measured through the overlap or transvariation effect.

In Argentina the analysis of regional and personal distribution of income has been present on the research agenda of public policy. They were put forward since the time of the national organization and the National Constitution of 1853. And the concern remains until now and governments have implemented policies to improved them. Cont and Porto (2014, 2016a, 2017) study extensively the construction of income distributions due to the execution of fiscal policy in Argentina. Succinctly, they analyze the effect of fiscal policy on income distribution allocating expenditures following a benefit principle and allocating taxes on an incidence basis. Some of the main results are: i) the effect of consolidated (national and provincial) fiscal policy is a reduction of income inequality by 7,3 points in the average 1995-2010; ii) the impact is very different among the 24 provinces but in all of them fiscal policy improves income distribution; (iii) provincial expenditures are more progressive than the national expenditure and explain 74% of the positive impact of expenditures on income distribution; (iv) national taxes are regressive and explain most of the tax side of the redistributive effect (provincial taxes have a slightly redistributive effect). We borrow such developments –specifically for year 2010– and consider them as given in this paper. In those papers, however, we considered pools of individuals (quintiles at the national or provincial levels). Fiscal policy did not produce reranking at such aggregate level. But fiscal policy produces reranking when an aggregate unit is composed of many individual income units.

In this paper we organize results from the literature, provide a new decomposition of the redistributive effect of fiscal policy that matches a decomposition of the reranking effect provided by Monti et al. (2012) when individual units belong to identifiable groups, and apply the measures to study the distributive impact of consolidated (nation-provinces) fiscal policy on personal and regional income distribution.

The paper develops as follows. Section 2 presents a conceptual framework of the different contributions of the redistributive effect of fiscal policy. Three subsections advance further in the decomposition of the redistributive effect when there are different groups of income units. Section 3 applies the results to the case of Argentina for year 2010. Section 4 engages in the decomposition of redistributive, vertical and reranking effects when income units are

pooled in different groups. Section 5 concludes. Two Appendixes provide complementary information.

2. Conceptual framework

Let $X=\{x_i\}$ and $Y=\{y_i\}$ be two distributions of income for a population with N individuals. By assuming that individuals weigh p_i (such that $\Sigma_i\ p_i = 1$) the setup allows for flexible interpretations: they may be individual households ($p_i=1/N$) or weighted units such as provincial quintiles or provinces in a country (being p_i the population size of a quintil-province or a province). We are interested in studying changes in income distribution caused by fiscal policy. Let

$$y_i = x_i + g_i - t_i$$

where x_i is ex ante income, g_i is expenditure benefits, t_i represents taxes and y_i is ex post or extended income corresponding to individual unit i.

We use a measure to summarize inequality associated to each distribution of income. Let the concentration index for any distribution A, given the ordering of distribution B, be $C_{A|B}$. For example, the distribution of ex post income, preserving the order according to ex ante income, is $C_{Y|X}$. The Gini coefficient of inequality corresponds to the concentration index for distribution A given the ordering of this distribution. In this case, $G_X = C_{X|X}$ and $G_Y = C_{Y|Y}$.

2.1. Fiscal policy and redistribution: vertical and reranking effects

The literature has analyzed different measures of redistribution. In this paper we consider the Redistribution Effect (RE) as the difference between ex-ante and ex-post Gini coefficients:[1]

$$RE = G_X - G_Y \tag{1}$$

where RE is definite positive if there is reduction of inequality (Kakwani, 1984, 1986, and Reynolds and Smolensky, 1977).

Given the information used in this paper, we consider the case that individual units have different ex ante income $\{x_i\}$. This way we disregard horizontal effects (i.e., unequal treatment of equals).[2] A decomposition of the redistribution effect (1) is

$$RE = \left(G_X - C_{Y|X}\right) + \left(C_{Y|X} - G_Y\right) = RS - R^{AP} = V^K - R^{AP} \tag{2}$$

[1] Other measures were proposed by Musgrave and Thin (1948): $RE^{MT} = (1-G_Y)/(1-G_X)$; and Kakwani (1984): $R^K = (G_X-G_Y)/G_X$. Moreover, other authors explored measures of the redistributive effect in a context of general Welfare functions (Aronson, Johnson and Lambert, 1994; Duclos, Jalbert and Araar, 2003).

[2] The analysis of pseudo horizontal effects is possible in this paper if we decompose the population in groups of "close equals" (van de Ven, Creedy and Lambert, 2001; Urban and Lambert, 2008). We do not pursue this line of research here but mention it in passing.

where the first term is the Reynolds-Smolensky effect of income redistribution –positive definite– and the second term R^{AP} is the "reranking effect" (Atkinson, 1980, Plotnick, 1981; see also Lambert, 1985, 1988).[3] Kakwani (1984, 1986) showed that the redistributive effect is a "vertical" effect of fiscal policy if individual income units preserve their order in the original (ex-ante income) ranking: $RE = V^K$.

Both effects received significant attention in the literature. Consider first that income units do not reorder after fiscal policy, so that $C_{Y|X} = G_Y$. The RS effect is fully decomposed into fiscal-policy contributions (Reynolds and Smolensky, 1977). Taking the results from Kakwani, specifically $K_t = G_X - C_{t|X}$ and $K_g = C_{g|X} - G_X$, where K_t and K_g are the Kakwani (1977) indexes of tax and expenditure progressivity (defined as the difference –properly measured– between the concentration of income and the concentration of the fiscal instrument) there is a link between the RS coefficient and the Kakwani coefficients:

$$RS = \tau . K_t + \gamma . K_g \tag{3}$$

where t and g are sizes of taxes and expenditures, respectively, measured as percentage of ex ante income, and $\tau = t/(1-t+g)$ and $\gamma = g/(1-t+g)$ are the corresponding sizes of taxes and expenditures, adjusted by surplus / deficit of the fiscal accounts (see Kakwani, 1977, 1984; Lambert, 1985, 1988; Jenkins, 1988). In the case of balanced budget ($t=g$),

$$RS = t.\left(K_t + K_g\right)$$

Equation (3) and the balanced-budget version show that, absent reranking, the redistribution effect can be fully decomposed into progressive and size effects of fiscal policy. This decomposition was widely studied by Reynolds and Smolensky (1977), Jenkins (1988) and others at the international level, and by Ahumada et al. (1996) and Cont and Porto (2014) in Argentina, and Cont and Porto (2016a, 2016b) with the data base used in this paper.

Consider now that income units change places after fiscal policy. Kakwani (1984, 1986) finds that the vertical effect V^K overestimates RE when there is reordering. Of course, the same happens with the RS decomposition. The difference between RE and V^K in equation (2) is known as the "reranking effect" (Atkinson, 1980; Plotnick, 1981) and is caused by the reordering of income units.

It is worth noticing that, throughout the literature, several Gini decompositions involved a residuum. Some authors found it difficult to explain (Mookherjee and Shorrocks, 1982) or explained it partially by reranking (Silber, 1989), or by differences in concentration areas (Bhattacharya and Mahalanobis, 1967), or attached an interpretation of expected value of a game played by individuals (Pyatt, 1976). Aronson, Johnson and Lambert (1994) linked the

[3] At the time of the book by Reynolds and Smolensky (1977), reranking was not an issue and hence the RS effect was captured through $G_X - C_{Y|X}$ (see Urban, 2009).

residuum to the reranking effect introduced by Atkinson and Plotnick.[4] By construction, the reranking effect ($R^{AP} = G_Y - C_{Y|X}$) is non-negative definite.

Atkinson (1980) argued that changes in the ranking of observations do not affect the degree of inequality in the ex post distribution nor the redistributive effect. Rather, he regarded the reranking as a difference between two measures of redistribution effect (*RE* and *V*). Urban (2009b), taking on Atkinson and Plotnick, clarifies this argument by stating that reranking is a by-product of an income redistribution process; but that it does not contribute, positively or negatively, to the redistributive effect. Moreover, Urban (2009a) shows that reranking of income units does not influence the redistributive effect. In fact, the redistributive effect captures the narrowing of distance between income distributions, and reranking and vertical effects are endogenous results. A summary of the observations by Atkinson and Urban can be put this way: comparing any two distributions of income, *RE* is the difference of the Gini coefficients attached to both distributions. Given *RE*, if there is more (less) reranking, then there is more (less) vertical effect, and vice-versa.[5]

Finally, before having coined the reranking name, this effect had been referred to as a "horizontal effect" (Kakwani, 1984, 1986) because it seemingly captured the unequal treatment of equals. The horizontal effect was initially measured by Aronson, Johnson and Lambert (1994) and Aronson and Lambert (1994) over distributions that include ex ante exact equals. This way, the authors decomposed vertical and horizontal effects from reranking. The specific relationship is:

$$RE = V^{AJL} - H^{AJL} - R^{AJL}$$

In addition, the authors showed that $R^{AP} = R^{AJL}$. Again, the net $V - H$ effect overestimates *RE* when there is reordering.

On another line of research, Duclos, Jalbert and Araar (2003) decomposed the same effects, using a class of social welfare functions that considers both aversion to riskiness in net incomes and aversion to rank inequality, and encompasses both Gini and Atkinson coefficients:

$$RE = V^{DJA} - H^{DJA} - R^{DJA}$$

[4] Other decompositions have been studied in the literature. The research line followed by Duclos (1993) considers an ordering of selected instruments of fiscal policy, for example, $\{t_1,t_2,g_1,g_2,g_3\}$. The decomposition following an ordering is useful in identifying which tax or expenditure is more important in determining re-ranking. Jenkins (1988) proposes two decompositions to (2), the first one is equal to (3) -see equation (9) of his paper- and the second one being a decomposition into (i) interim distribution of ex ante income minus taxes and (ii) interim distribution of ex ante income plus expenditures (see equation (10) of his paper). However, this alternative approach to measuring fiscal policy effect and reranking cannot be matched to the traditional Kakwani vertical effect of taxes and expenditures so we do not pursue it here.

[5] Lerman and Yitzhaki (1995) represented the vertical and reranking effects starting from the ex post income distribution. The *RE* is, in this case, the sum of vertical and reranking effects. Consequently, the decomposition of *RE* between a vertical effect and reranking effect pivoting on ex ante ordering (as in Kakwani-Atkinson-Plotnick) or pivoting on ex post ordering (as in Lerman and Yitzhaki) is a practical matter, depending on the researcher preference to preserve pre-fiscal or post-fiscal rankings.

According to the authors, V^{DJA} represents the decrease in inequality yielded by a tax which treats equals equally, H^{DJA} measures the increase in overall income inequality attributable to the unequal post-tax treatment of pre-tax equals, and R measures the extent of reranking.

Given that data bases rarely contained exact ex ante income units, van de Ven, Creedy and Lambert (2001) and Urban and Lambert (2008) extended the analysis to groups of ex ante *close* equals.[6] Urban and Lambert (2008) also reconsidered the interpretations of vertical, horizontal and reranking effects taking into consideration the possibility of reranking within close equals (WG) and reranking of entire groups (EG). In particular, they show that

$$RE = V^{UL} - H^{UL} - R^{AP}$$

where $V^{UL} = V^{AJL} + R^{EG}$, $H^{UL} = H^{AJL} - R^{WG}$ and $R^{AP} = R^{AJL} + R^{WG} + R^{EG}$.

2.2. Reranking when individual units belong to mutually exclusive groups

Assume now that $\{x_i\}$ is partitioned into S groups of size N_S, such that individual units within group s_j have –not necessarily similar– ex ante income in $[x_{SjL}, x_{SjU}]$, which possibly overlap with income of individual units within group s_k $[x_{SkL}, x_{SkU}]$. This way, individual units belong to mutually exclusive groups. Relabel x_i as $x_{i,s}$ and y_i as $y_{i,s}$ (individual i, group s), such that average incomes are μ_X (ex ante average income), $\mu_{X,s}$ (ex ante average income of group s), μ_Y (ex post average income) and $\mu_{Y,s}$ (ex post average income of group s).

With this information, the Gini coefficient can be decomposed as in Bhattacharya and Mahalanobis (1967), Pyatt (1976), Silber (1989), Lambert and Aronson (1993), or Dagum (1997):[7]

$$G_X = G_X^W + G_X^A = G_X^W + G_X^T + G_X^B$$

that is, given the distribution $X=\{x_i\}$, the Gini coefficient of inequality can be additively decomposed into the following effects: inequality within groups ($G_X{}^W$) and inequality across groups ($G_X{}^A$), which can be decomposed into inequality due to the possibility that income of units belonging to low-income groups is higher than income of units belonging to high-income groups (this effect is known as overlap or trans-variation; we use the second term: $G_X{}^T$) and inequality due to difference of mean income between groups ($G_X{}^B$). After the introduction by Bhattacharya and Mahalanobis (1967) and Pyatt (1976), this decomposition was explored in Argentina by Dieguez and Petrecolla (1978), Porto and Cont (1998). Lambert and Aronson (1993) present a similar decomposition, and identifiy a residuum as the overlapping effect of income units from different groups. Dagum (1997) suggests a similar decomposition as in Pyatt (1976), and defines the transvariation effect.

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[6] They study the case of distributions $\{x_i\}$ that can be partitioned into s groups of size N_S, such that all individual units within group s have ex ante income $x_{i,s}$ in $[x_{SL}, x_{SU}]$ and that the lower bound (SL) and upper bound (SU) at group level are such that groups do not overlap.

[7] In two separate works, Monti (2007) and Griffiths (2008) show that the traditional measures (Pyatt, Silber) and newer measures (Dagum) are all identical.

Monti et al. (2012) use the later definition to decompose the reranking effect when income distributions can be partitioned in groups. This way, reranking can be adapted to the case with groups which may overlap before and after taxes. Specifically, the authors show that the concentration index of ex post income (given ex ante ordering) $C_{Y|X}$ can be decomposed into

$$C_{Y|X} = C^{W}_{Y|X} + C^{A}_{Y|X} = C^{W}_{Y|X} + C^{T}_{Y|X} + C^{B}_{Y|X} \quad (4)$$

The reranking effect, defined in equation (2) as $R^{AP} = G_Y - C_{Y|X}$, is decomposed as

$$R^{AP} = G^{W}_{Y} + G^{A}_{Y} - C^{W}_{Y|X} - C^{A}_{Y|X} = R^{W} + R^{A} \quad (5)$$

In other words, the reranking effect can be decomposed into within-group reordering (i.e., how much of the reordering is taking place between income units belonging to the same group) and across-group reordering (i.e., how much reordering is taking place between richer units in poor groups vs. poorer units in rich groups). Finally, although the decomposition of across-group reranking (R^A) into an overlapping / transvariation component ($R^T = G^T_Y - C^T_{Y|X}$) and a between-group component ($R^B = G^B_Y - C^B_{Y|X}$) is mathematically feasible, the authors argue that they are not proper measures of reranking.

2.3. Vertical effect when individual units belong to mutually exclusive groups

Assume, as in Section 2.2, that that $\{x_i\}$ is partitioned into mutually exclusive s groups of size N_S, and that income of individual units possibly overlaps. Taking equation (4) as reference it is not difficult to figure out that the same equality holds for concentration coefficients of any variable (say, t or g) preserving the ordering X.

Proposition 1: *Assume that individuals are pooled in S mutually exclusive groups Consider that individuals identified by a pair of variables (X,Z) and are ordered according to variable X (first, increasing order of average x among groups; second, increasing order of individual x within groups). The concentration coefficient of variable Z, given the partition into s groups and the ordering X, can be decomposed into:*

$$C_{Z|X} = C^{W}_{Z|X} + C^{A}_{Z|X} = C^{W}_{Z|X} + C^{T}_{Z|X} + C^{B}_{Z|X}$$

Proof: see Appendix A.3.

Proposition 1 is helpful to decompose the Vertical / Reynolds Smolesnky coefficient in the presence of groups. The first result is summarized in

Proposition 2: *Assume that individuals are pooled in S mutually exclusive groups. Consider that are individuals identified by a pair of variables (X,Y), where X is ex ante income and Y is ex post income, and are ordered according to variable X (first, increasing order of average x among groups; second, increasing order of individual x within groups). Then the Vertical Effect can be decomposed into within and across (and also into between and transvariation) effects:*

$$V = V^W + V^A = V^W + V^T + V^B \quad (6)$$

The proof is straightforward.

Next proposition shows that Kakwani coefficients and tax and expenditure effects of the Vertical / Reynolds Smolensky coefficient (equation (3)) can be further decomposed in the presence of groups.

Proposition 3: *Assume that individuals are pooled in S mutually exclusive groups, and are ordered according to variable X (first, increasing order of average x among groups; second, increasing order of individual x within groups). The Kakwani coefficients for expenditures and taxes can be decomposed as*

$$K_Z = K_Z^W + K_Z^A = K_Z^W + K_Z^T + K_Z^B$$

where $K_Z^A = K_Z^T + K_Z^B$, *for z=t,g.*

The vertical / Reynolds Smolensky effect can be decomposed as

$$RS = \tau.(K_t^W + K_t^T + K_t^B) + \gamma.\left(K_g^W + K_g^T + K_g^B\right)$$
$$= RS^W + RS^T + RS^B \quad (7)$$

where $RS^l = \tau.K_t^l + \gamma.K_g^l$, *for l = W, T, B, and* $RS^A = RS^T + RS^B$.

Proposition 3 takes relevance in contexts where redistribution is the sum of different effects from fiscal policy and groups are involved. As we will discuss below, there are at least two interesting classifications of Argentine provinces in the context of income redistribution, which are related to the characteristics of provinces, in particular, their level of development or whether they finance or benefit from national tax sharing schemes.

3. Application: the case of Argentina

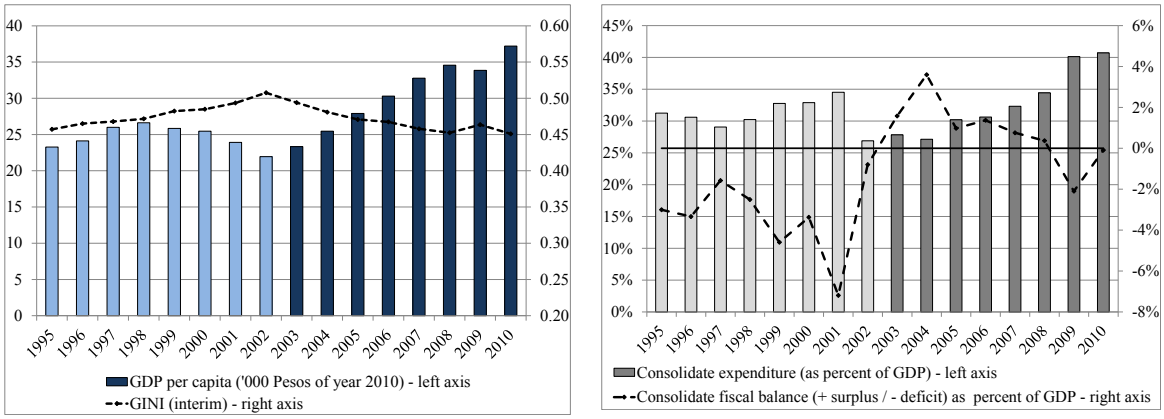
3.1. Context

Argentina is a country located in South America. Per capita income exceeded US$ 9,000 in 2010. This average, however, hides large regional disparities, with provincial incomes ranging from US$ 27,508 in the city of Buenos Aires to US$ 3,781 in the province of Santiago del Estero. Such disparities also hold for other social indicators (Unsatisfied Basic Needs, for example), although other indicators may indicate less provincial heterogeneity (Human Development Index). Table B1 in Appendix B contains detailed information and explanations on these indicators.

Like many other developing countries, Argentina underwent cyclic socioeconomic conditions. During the 1990s the prevailing socio-economic regime was referred to as "Convertibility", which was a characterized by fixed exchange rate of the Argentine peso to the US dollar, macroeconomic stability and tight fiscal accounts, until it underwent an

economic crisis in 2002 (see Figure 1). Since 2003, the period known as "post-Convertibility" was characterized by high real exchange rate, high inflation and slack fiscal accounts. The economy engaged in steady growth accompanied by decreasing inequality (2003-2010). The left panel of Figure 1 shows the evolution of GDP and of income inequality (summarize through the Gini coefficient).

Figure 1. Evolution of per capita GDP (in thousands of constant Argentine pesos of 2010), income inequality (Gini index), and consolidated –national and provincial– fiscal expenditure and balance (percent of GDP)



The consolidated nation-provinces expenditure oscillated between 29 percent and 35 percent of GDP during 1995-2001, to later plummet to around 27 percent of GDP during the following three-year period.[8] Since then, it grew constantly to peak 40 percent in the last year of the sample.[9] Tax pressure kept it up to a higher pace, from 28 percent of GDP in 1995-2001 to 34 percent of GDP in 2003-2010 (almost 40 percent in 2010), turning the fiscal balance from an average 4-percent deficit to an average 1-percent surplus (see right panel of Figure 1). As explained in other papers, fiscal policy redistributed income during the period 1995-2010 both in the personal dimension (Cont and Porto, 2014, 2016a, 2016b) and in the regional dimension (Cont, Porto and Juarros, 2017).

3.2. Redistribution and reranking. Provinces of Argentina. 2010

We select 2010 as the year of analysis in this paper, which is characterized by growth, decreasing inequality and balanced fiscal accounts.[10] Table 1 shows the quantifications of

[8] Municipal budgets are excluded because detailed information is unavailable. They represent around 8 percent of total expenditure in Argentina. Nonetheless, they are partially considered in the analysis through the transfers from provinces to municipalities (which represent about half of municipal expenditures).

[9] In 2014 the Argentine government changed the base year of national accounts. As said in the main text, consolidated expenditure represented 40 percent of GDP in 2010. With the new accounts the share decreased to almost 30 percent. The public sector continued growing in Argentina to peak 42.5 percent of the GDP (new accounts) in 2015.

[10] A complete analysis of the full period 1995-2010 is beyond the scope of the paper. On the one hand, a full study of redistribution by different approaches (national vs provincial budget, cash vs in kind expenditures,

ex ante Gini (G_X), the concentration index of ex post income with the initial order of income distribution ($C_{Y|X}$), the ex post Gini (G_Y) and the redistribution effect ($RE = V - R$). Personal RE was 0.098, or 19 percent of ex ante Gini (which was 0.512), and regional RE was 0.032, or 12 percent of ex ante Gini (which was 0.267). This Table also presents the decomposition of the RE effect between the vertical/Reynolds-Smolensky effect and reranking. In the case of redistribution of personal income, the vertical effect was 0.102 and the reranking effect 0.004 (4 percent of personal RE). In the case of redistribution of regional income, the vertical effect was 0.036 and the reranking 0.004 (10 per cent of RE). Under both definitions of income, R compensates a fraction of the V effect as fiscal policy in Argentina creates reranking of income units under both definitions of income. The reranking effect is stronger on the regional dimension than on the personal dimension.

Table 1. Gini ex ante and ex post, concentration index of ex post income, redistribution effect and decomposition between vertical and reranking effects. Consolidated (Nation and provinces) fiscal policy. 2010.

Personal distribution of income							
G_X	0.512	$C_{Y\|X}$	0.410		G_Y	0.414	
G^W_X	0.072	$C^W_{Y\|X}$	0.054		G^W_Y	0.054	
G^A_X	0.440	$C^A_{Y\|X}$	0.356		G^A_Y	0.360	
G^T_X	0.173	$C^T_{Y\|X}$	0.124		G^T_Y	0.125	
G^B_X	0.267	$C^B_{Y\|X}$	0.231		G^B_Y	0.235	
					RE	0.098	
		V	0.102		**R**	0.004	
		V^W	0.018	17%	R^W	0.000	0%
		V^A	0.085	83%	R^A	0.004	100%
		V^T	0.049	48%			
		V^B	0.036	35%			

Considering the personal dimension, even though reranking may seem low, it is in line with effects estimated by the literature. For example, Aronson and Lambert (1994, p. 291) estimate a 5 percent reranking effect in British tax policy (based on fiscal data of the United Kingdom family expenditure survey). The same authors refer to data from Marenzi (1993) to find a 1.8 percent reranking effect in Italy tax policy. Urban and Lambert (2008) estimate a 12 percent reranking effect caused by direct taxes in Croatia for year 2003. Monti et al. (2012) estimate a 5.7 percent reranking effect caused by taxes and government transfers in

etc.) is done in Cont and Porto (2016a and 2016b). In this paper we borrow the results from year 2010 to analyze further effects by groups to differentiate the redistributive effect between vertical effect and reranking. The inclusion of 15 more years does not add significant results to the analysis.

the US for year 2007. Curiously, Kim and Lambert (2007) estimated a 36 percent reranking effect caused by a broad definition of fiscal policy in US for year 2004. Duclos, Jalbert and Araar (2003) present an illustration of a measure that combines the Gini and Atkinson coefficients for Canada in 1981-1995 and find erosion due to horizontal inequality and reranking of about 15 to 21 percent of the net redistributive effect.[11]

We should note that expression (2) is calculated based on Gini coefficients and both terms (V and R) have the same weight. It would be possible to expand the measurement of inequality indexes (Atkinson – like) and introduce a normative treatment. For example, in the case of the vertical effect, value judgments could go from Bentham (utilitarism, according to a Welfare function which is the sum of individual utilities or incomes) to Ralws (according to which, the Welfare function attaches a "maximin" conception of justice by considering the utility or income of the worst-off individual). On the other hand, there is no ethical foundation for R in this context of fiscal policy.[12]

Considering the regional dimension, reranking of provinces is a relevant issue in public finance. In the presence of territorial economic imbalances (horizontal disequilibrium) schemes of fiscal equalization are implemented in almost every country. In this way, "richer" regions transfer income to "poorer" regions through the national budget and revenue sharing regimes. In the analysis of reranking an important point is how to define the initial order of the regions. For example, per capita income is the standard variable to rank income unit in all cited research papers and is the decisive factor to rank provinces in the autonomous community of Catalonia (Spain), but own revenue is the variable to rank provinces in Germany.

Fiscal equalization rules are typically a source of political conflict (Cubel, 2014). For example, in Germany, the 1993 Equalization Law was repealed by rich Lander and the Federal Constitutional Court shifted to a partial equalization scheme to avoid reranking. In Catalonia, the equalization rules of the 2006 Catalan Constitution were blocked by the Constitutional Court of Spain.

The data of Table 1 reveals the existence of reranking among provinces in Argentina when the initial order is per capita income. In fact, reranking is much stronger if the initial ranking is based on the provincial revenues (as in Germany), a fact pointed out by Porto (2017). Table B1 in Appendix B provides more details and shows that many provinces benefit from redistribution, but to different degrees. For example, poor provinces like Formosa, La Rioja or Santiago del Estero scale several positions in the ranking based on ex post income, while other provinces that also benefit from redistribution scale less

[11] Urban (2009b) presents an overview of studies on redistributive effect of fiscal policy between 1977 and 2009 in Tables 4 a 6.

[12] As mentioned before, R could be attached a social mobility interpretation in a growth – inequality context. But such interpretation cannot be applied to the effects of fiscal policy on income distribution as measured in this literature.

(Catamarca, Río Negro or Jujuy) or even lose positions (Salta, Corrientes or Tucumán). The province of Buenos Aires contributes to redistribution and loses positions, while the city of Buenos Aires also contributes to redistribution but keeps separated from the rest of the jurisdictions.

The change in rankings because of intergovernmental transfers and geographic allocation of national expenditures is one of many sources of conflicts that have been present in Argentina. For example, the Constitution of 1994 ordered the enacting of a new Revenue Sharing Law by the end of 1996. After 20 years, the law has not been passed yet. More recently, in the midst of political conflicts of this kind, the province of Buenos Aires filed a lawsuit before the Supreme Court of Argentina in 2016 after having been disadvantaged by distribution rules in effect for the last 17 years.

Given the information structure in this section, Tables 2 and 3 present a first decomposition of redistributive effect for national and provincial fiscal policy.

Table 2. Gini ex ante and ex post, concentration index of ex post income, redistribution effect and decomposition between vertical and reranking effects. National fiscal policy. 2010.

Personal distribution of income							
G_X	0.512	$C_{Y\|X}$	0.489		G_Y	0.490	
G^W_X	0.072	$C^W_{Y\|X}$	0.067		G^W_Y	0.067	
G^A_X	0.440	$C^A_{Y\|X}$	0.422		G^A_Y	0.423	
G^T_X	0.173	$C^T_{Y\|X}$	0.158		G^T_Y	0.159	
G^B_X	0.267	$C^B_{Y\|X}$	0.264		G^B_Y	0.264	
					RE	0.022	
		V	0.023		**R**	0.001	
		V^W	0.005	20%	R^W	0.000	0%
		V^A	0.018	80%	R^A	0.001	100%
		V^T_X	0.015	66%			
		V^B_X	0.003	14%			

Two important results are: i) there is no incompatibility between the distributive policy of both levels of government because both improve personal income distribution; ii) provincial budget is more important explaining 77% of the decrease of Gini.[13] The

[13] A clarification is in order. In Tables 2 and 3, national expenditure is financed with national taxes, which are net of funds that are transferred to provinces, while provincial expenditures are financed with local taxes and transfers (coparticipation and others) from the national government. In Table 4, taxes are calculated based on the level of government in which they are collected. This way, national taxes correspond to the sum of taxes retained by the national government and those transferred to provinces. In this case, a minor share of the

disaggregation of ex post Gini is similar in the two cases and also the vertical effect (more than 80% across provinces): the overlapping effect ($V^T_{X)}$ is percentage higher for the national budget (66% vs 43%) but the difference of mean (V^B_X) is percentage lower for the national (14% vs 41%).

Table 3. Gini ex ante and ex post, concentration index of ex post income, redistribution effect and decomposition between vertical and reranking effects. Provincial fiscal policy. 2010.

Personal distribution of income							
G_X	0.512	$C_{Y\|X}$	0.434		G_Y	0.436	
G^W_X	0.072	$C^W_{Y\|X}$	0.059		G^W_Y	0.059	
G^A_X	0.440	$C^A_{Y\|X}$	0.375		G^A_Y	0.377	
G^T_X	0.173	$C^T_{Y\|X}$	0.140		G^T_Y	0.140	
G^B_X	0.267	$C^B_{Y\|X}$	0.235		G^B_Y	0.237	
					RE	0.075	
		V	0.078		**R**	0.002	
		V^W	0.013	16%	R^W	0.000	0%
		V^A	0.065	84%	R^A	0.002	100%
		V^T_X	0.033	43%			
		V^B_X	0.032	41%			

Table 4 presents a summary of the Reynolds-Smolensky (vertical) coefficient for personal distribution. Consider first the decomposition of fiscal budget between national and provincial levels: provincial expenditure is highly progressive, followed by national expenditure. Consolidated (national - provincial) expenditure is divided evenly between levels of governments. Taxes are regressive, but national taxes have stronger redistributive effect as they represent 70% of consolidated (national – provincial) revenues. Next, consider the decomposition of fiscal budget between cash transfers and in-kind expenditures.[14] In-kind expenditure is the most redistributive tool, followed by cash

vertical effect (0.016 out of 0.102) corresponds to national expenditures and taxes and a larger share of the vertical effect (0.086 out of 0.102) corresponds to provincial expenditures and taxes.

[14] Cash transfers are public expenditures that go directly to individuals in cash (social security, social programs, etc.), and constitute a source of interim income (usually, the income declared in household surveys). In kind expenditures are public expenditures that benefit individuals through the services they render (education, health, some public subsidies to sustain lower prices of certain services –mainly transport and energy–, etc.). Taxes related to cash transfers (denominated $t_{\times C}$ in Table 2) are taxes paid by economic agents at the time of receiving their income (mostly, labor and income taxes). Taxes related to in kind expenditures (denominated $t_{\times E}$ in Table 2) are taxes collected after agents receive their income (consumption taxes, property taxes, etc.). Although there is a high correlation between direct taxes and $t_{\times C}$, and between indirect taxes and $t_{\times E}$, they are not strictly the same.

expenditures. As expected, $t_{\times E}$ is more regressive than $t_{\times C}$, and also weighs more in a country where indirect taxation takes a high share of total taxes.

Table 4 also decomposes the Reynolds-Smolensky (vertical) effect for regional distribution of income. Expenditure is less progressive and national taxes are more regressive when the effects are calculated over 24 provincial jurisdictions rather than 120 income units (quintil-provinces). On the other hand, provincial taxes are less regressive. These results are reasonable from an aggregate point of view: treating all quintiles in a province equally in a regional comparison, provincial expenditures (which are the main progressive tool to explain the redistribution effect) are less progressive and also provincial taxes are less regressive, when analyzed under a regional definition of income. Overall, the redistributive effect is lower at the regional level, mainly because of the reduced progressive effect of provincial expenditures (provided that sizes are the same under both definitions of income distribution).

Table 4. Decomposition of the vertical – Reynolds Smolensky effect: national – provincial budgets; cash-in kind expenditures / direct-indirect taxes, 2010.

National - Provincial decomposition of RS			Cash-In Kind decomposition of RS		
	Personal	Regional		Personal	Regional
τ_N	0.303	0.303	$\tau_{\times C}$	0.104	0.104
K_{tN}	-0.122	-0.156	$K_{t\times C}$	-0.062	-0.209
τ_P	0.084	0.084	$\tau_{\times E}$	0.283	0.283
K_{tP}	-0.115	-0.046	$K_{t\times E}$	-0.142	-0.104
γ_N	0.212	0.212	γ_C	0.122	0.122
K_{gN}	0.250	0.196	K_{gC}	0.326	0.224
γ_P	0.176	0.176	γ_E	0.265	0.265
K_{gP}	0.543	0.256	K_{gE}	0.409	0.223
V (RS)	0.102	0.036	V (RS)	0.102	0.036

Notes: t_N (t_P) are the tax rates –as a percentage of GDP– collected at the National (Provincial) levels, g_N (g_P) the average expenditure –as a percentage of GDP– spent by the National (Provincial) level. Then $\tau_N=t_N/(1-t_N-t_P+g_N+g_P)$, $\tau_P=t_P/(1-t_N-t_P+g_N+g_P)$, $\gamma_N=g_N/(1-t_N-t_P+g_N+g_P)$ and $\gamma_P=g_P/(1-t_N-t_P+g_N+g_P)$. See details in equation (3). The same definitions apply for a decomposition of cash (C) and in-kind (E) expenditures and the taxes collected directly (×C) and indirectly (×E). The results on redistribution of personal income reported in this table are consistent with those reported in Cont and Porto (2016a).

4. Redistribution and reranking effects under different groups

In this section we consider two group partitions for provinces and income units. We describe and analyze the relevant decompositions in two separate subsections.

4.1. Group of Advanced, Low Density, Intermediate and Lagged provinces

The first classification clusters provinces into four groups according to a criterion of similar economic and social development, following the methodology proposed by Nuñez Miñana

(1972). The four groups are denominated Advanced, Low Density, Intermediate and Lagged, making reference to the level of development of provinces belonging to each group. Using the terminology of Section 2, *S=4*, and each *s* includes individual units depending on the number of provinces in each group:[15] the Advanced group consists of 5 provinces (25 quintiles), the Low-Density group consists of 6 provinces (30 quintiles), the Intermediate group consists of 5 provinces (25 quintiles), and the Lagged group consists of 8 provinces (40 quintiles). Figure B1 – left panel in the Appendix depicts the Argentine provinces according to this classification.

Tables 5 and 6 show the decomposition of the Gini, concentration, progressiveness and redistribution indexes within-groups and across-groups (and also between groups and overlapping of income units from different groups) for the definition of personal distribution of income.

Ex ante income inequality in year 2010 (G_X = 0.512) is evenly distributed between within-group inequality (0.263) and across-group inequality (0.248). Moreover, across-group inequality is explained by differences in groups' average income (54 percent: 0.134 out of 0.248) and income overlapping of units belonging to different groups (46 percent: 0.114 out of 0.248).

The redistribution effect of consolidated fiscal policy is 0.098 in that year, reducing the Gini coefficient to 0.414. *RE* is the net result of a vertical effect (V = 0.102) partially compensated by reranking (R = 0.004).

Table 5. Group A, LD, I, L - personal distribution of income: decomposition of RE, V and R into within, between and transvariation components, 2010.

Personal distribution of income							
G_X	0.512	$C_{Y\|X}$	0.410		G_Y	0.414	
G^W_X	0.263	$C^W_{Y\|X}$	0.213		G^W_Y	0.215	
G^A_X	0.248	$C^A_{Y\|X}$	0.197		G^A_Y	0.199	
G^I_X	0.114	$C^I_{Y\|X}$	0.088		G^I_Y	0.089	
G^B_X	0.134	$C^B_{Y\|X}$	0.109		G^B_Y	0.110	
					RE	0.098	
		V	0.102		**R**	0.004	
		V^W	0.051	50%	R^W	0.002	51%
		V^A	0.051	50%	R^A	0.002	49%
		V^T	0.026	25%			
		V^B	0.026	25%			

[15] The group of Advanced Jurisdictions includes the city of Buenos Aires, and the provinces of Buenos Aires, Córdoba, Mendoza and Santa Fe. The group of Intermediate Jurisdictions comprises Entre Ríos, Salta, San Juan, San Luis and Tucumán. The group of Low Density Jurisdictions includes Chubut, La Pampa, Neuquén, Río Negro, Santa Cruz and Tierra del Fuego. The group of Lagged Jurisdictions comprises Catamarca, Chaco, Corrientes, Formosa, Jujuy, La Rioja, Misiones and Santiago del Estero.

The empirical estimation of equations (5)-(6) to the four-group classification shows the interesting result that both the vertical a reranking effects are also evenly distributed between within-group and across-groups effects, and that the redistributive vertical effect across groups also distributes evenly between reduction of average incomes and reduction of income overlaps.

Table 6 further explores the vertical / Reynolds-Smolensky effect for the national-provincial and the cash-in kind decomposition of consolidated budget presented in Table , following the proposal in equation (7), and shows more interesting results.

Table 6. Group A, LD, I, L - personal distribution of income: Decomposition of the vertical – Reynolds Smolensky effect into within, between and transvariation components, 2010.

National - Provincial decomposition of RS					Cash-In Kind decomposition of RS				
	Full	W	T	B		Full	W	T	B
τ_N	0.303				$\tau_{\times C}$	0.104			
K_{tN}	-0.122	-0.069	0.008	-0.060	$K_{t\times C}$	-0.062	-0.047	0.060	-0.074
τ_P	0.084				$\tau_{\times E}$	0.283			
K_{tP}	-0.115	-0.086	-0.086	0.057	$K_{t\times E}$	-0.142	-0.082	-0.039	-0.020
γ_N	0.212				γ_C	0.122			
K_{gN}	0.250	0.133	0.017	0.100	K_{gC}	0.326	0.178	0.045	0.104
γ_P	0.176				γ_E	0.265			
K_{gP}	0.543	0.288	0.152	0.103	K_{gE}	0.409	0.215	0.094	0.100
V (RS)	0.102	0.051	0.026	0.026	V (RS)	0.102	0.051	0.026	0.026

In the case of national-provincial decomposition of the consolidated budget, we explained in Section 3 that the provincial expenditure was identified as the most progressive tool for income redistribution. The within-group effect of K_{gP} is very important, as it should be expected from a redistributive provincial tool (53 percent of 0.543), but there is also a side-effect in the reduction of overlapping (28 percent of 0.543). In this case, poor income units in high-income groups receive significantly more provincial expenditure than rich income units from low-income groups. This is a plausible result: provinces are engaged in redistribution within their own jurisdictions, and allocate resources to lower quintiles (including provinces with high income). Moreover, about 19 percent of the progressive effect corresponds to a reduction of disparities between groups, as provinces with lower average income (say, Intermediate and Lagged) engage in higher levels of provincial expenditure than provinces with higher average income (mainly, the Advanced group).[16]

[16] Provinces in the Low Density group, by the mere reason of having low population, display higher per-capita expenditures that provinces in Intermediate and Lagged group. But, on the other hand, their relative weight compared to other groups is low.

National expenditures are also progressive (K_{gN} = 0.250 in Table). Inasmuch redistributing income, the qualitative effects are like those of provincial expenditures. But the composition of national expenditure is balanced between progressiveness within groups and between groups. National taxes are regressive (K_{tN} = -0.122 in Table) with main effect within groups and between groups. There is no significant overlapping effect from national taxes and expenditures.

Provincial taxes are regressive (and have little redistributive effect because of size). However, the decomposition from equation (7) unravels certain aspects of provincial taxation that were unknown so far. On the one hand, the magnitude of the regressive transvariation effect is like that of the within-group effect. In this case, poor income units in high-income groups pay more provincial taxes than rich income units from low-income groups (increasing overlaps). On the other hand, the impact of provincial taxes is progressive between groups, partially counterbalancing the net regressive effect. For example, if we deduct provincial taxes from ex ante income, the difference in net-of-provincial-tax income is reduced between Lagged and Intermediate income units and produces a change in ranking between the Advanced and Low Density groups.

In the case of cash-in kind decomposition of the consolidated budget, we explained in Section 3 that the in-kind expenditure was identified as the most progressive tool for income redistribution (K_{gE} = 0.409) followed by cash-transfers (K_{gE} = 0.326). In both cases, within-group effect represents over 50 percent of de progressive effect, respectively. However, they have different progressive effect across groups: in the case of in-kind (cash) expenditure the between-group effect represents 24 percent (32 percent), while the transvariation effect represents 23 percent (14 percent), of the progressive effect. The overlapping effect of cash transfers is low (0,045) as the benefit received by income units belonging to different groups do not cause significant relative changes in ranking.

Taxes collected ex ante ($t_{\times C}$) also show interesting effects: they are regressive ($K_{t\times C}$ = -0.062), with a higher within effect (-0.047) than across (-0.015) effect. However, the latter effect hides a strong regressive between-effect (-0.074) partially compensated by an overlapping effect (0.060). On the one hand, high income groups contribute less to such taxes, in average; on the other hand, high income units belonging to poorer groups contribute more taxes than low income units belonging to richer groups (reducing overlapping). Finally, taxes collected after individuals receive their income ($t_{\times E}$) are regressive in all dimensions.

Next, we analyze the redistributive effect of consolidated fiscal policy for a distribution of income across provinces. Tables 7 and 8 show the decomposition of the Gini, concentration, progressiveness and redistribution indexes within-groups and across-groups (and also between groups and overlapping among groups) for the definition of regional income distribution.

Table 7. Group A, LD, I, L - regional distribution of income: decomposition of RE, V and R into within, between and transvariation components, 2010.

Regional distribution of income							
G_X	0.267	$C_{Y\|X}$	0.231		G_Y	0.235	
G^W_X	0.110	$C^W_{Y\|X}$	0.104		G^W_Y	0.105	
G^A_X	0.157	$C^A_{Y\|X}$	0.127		G^A_Y	0.130	
G^T_X	0.023	$C^T_{Y\|X}$	0.018		G^T_Y	0.020	
G^B_X	0.134	$C^B_{Y\|X}$	0.109		G^B_Y	0.110	
					RE	0.032	
		V	0.036		**R**	0.003	
		V^W	0.005	15%	R^W	0.000	9%
		V^A	0.030	85%	R^A	0.003	91%
		V^T	0.005	13%			
		V^B	0.026	72%			

Ex ante income inequality (G_X = 0.267) can be decomposed between within-group inequality (0.110) and across-group inequality (0.157). Moreover, across-group inequality is mostly explained by differences in average income among different groups (85 percent: 0.134 out of 0.157) and little by income overlapping of units belonging to different groups (15 percent: 0.023 out of 0.157).

The redistribution effect of consolidated fiscal policy is 0.032, reducing the Gini coefficient to 0.235. *RE* is the net result of a vertical effect (V = 0.036) partially compensated by reranking (R = 0.003).

From the empirical estimation of equations (5)-(6), we find that changes in average incomes between groups represent 72 percent of the across groups vertical effect. Also, the reranking effect is mostly explained by narrowing of differences across groups (91 percent). In both measures, within-group effects are small.

Table 6 further explores the vertical / Reynolds-Smolensky effect for the national-provincial and the cash-in kind decomposition of consolidated budget. Qualitative results are similar to those discussed for personal distribution of income. We highlight here that within-group effects of both national and provincial expenditures are lower than, and between-group effects are equal to, those obtained for the personal definition of income distribution.

In the case of cash-in kind decomposition, the overlapping effect of ex ante taxes ($t_{\times C}$) is regressive (it was positive in the case of personal distribution of income). Richer provinces in poorer groups contribute relatively less to ex ante taxes.

Table 8. Group A, LD, I, L - regional distribution of income: Decomposition of the vertical – Reynolds Smolensky effect into within, between and transvariation components, 2010.

National - Provincial decomposition of RS					Cash-In Kind decomposition of RS				
	Full	W	T	B		Full	W	T	B
τ_N	0.303				$\tau_{\times C}$	0.104			
K_{tN}	-0.156	-0.076	-0.019	-0.060	$K_{t\times C}$	-0.209	-0.108	-0.027	-0.074
τ_P	0.084				$\tau_{\times E}$	0.283			
K_{tP}	-0.046	-0.063	-0.040	0.057	$K_{t\times E}$	-0.104	-0.061	-0.023	-0.020
γ_N	0.212				γ_C	0.122			
K_{gN}	0.196	0.072	0.025	0.100	K_{gC}	0.224	0.091	0.029	0.104
γ_P	0.176				γ_E	0.265			
K_{gP}	0.256	0.105	0.049	0.103	K_{gE}	0.223	0.085	0.039	0.100
V (RS)	0.036	0.005	0.005	0.026	V (RS)	0.036	0.005	0.005	0.026

4.2. Group of Contributing and Beneficiary provinces

The second classification pools provinces in two groups –those who contribute to / benefit from regional redistribution– and works as follows: every year the national government raises taxes (which are collected in different provincial jurisdictions) and allocates resources into automatic and discretionary transfers (which are distributed among provinces according to coparticipation rules and national government's discretion, respectively) and national expenditures (which are distributed among provincial jurisdictions depending on expenditure incidence). The difference between taxes, expenditures and transfers generates a fiscal residuum in each province (see details in Cont, Porto and Juarros, 2017). Jurisdictions with negative residuum (contribute more taxes than benefit from expenditures and transfers) belong to the group of "contributors" or "financers" while those with positive fiscal residuum belong to the group of "beneficiaries". The number of jurisdictions in each group depends on regional redistribution of income every year. Using the terminology of Section 2, in year 2010 there are two groups ($S=2$), which include 5 contributing provinces and 19 beneficiary provinces under the definition of regional distribution of income, and 25 contributing units and 95 beneficiary units under the definition of personal distribution of income. The main difference with the classification according to socioeconomic development is that almost all Advanced jurisdictions and a Low Density province finance the remaining provinces. Figure B1 – right panel in the Appendix depicts both groups of provinces in 2010.

Tables 9 and 10 show the decomposition of the Gini, concentration, progressiveness and redistribution indexes within-groups and across-groups (and also between groups and overlapping among groups) for the definition of personal distribution of income. As expected, given that groups include more heterogeneous units, a higher proportion of ex ante income inequality ($G_X = 0.512$) is explained by within-group inequality (0.278).

The empirical estimation of equations (5)-(6) to the financing-beneficiary classification shows a quite even distribution of the vertical effect within and across groups. However, differences in average income of both groups represent higher share of the across-groups effect (0.033/0.048, or 69 percent of V^A). Also, as expected, reranking occurs with more intensity within-groups (66 percent) than across-groups (34 percent).

Table 9. Group Contributors / Beneficiaries - personal distribution of income: decomposition of RE, V and R into within, between and transvariation components, 2010.

Personal distribution of income							
G_X	0.512	$C_{Y\|X}$	0.410		G_Y	0.414	
G^W_X	0.278	$C^W_{Y\|X}$	0.224		G^W_Y	0.227	
G^A_X	0.234	$C^A_{Y\|X}$	0.186		G^A_Y	0.187	
G^T_X	0.102	$C^T_{Y\|X}$	0.087		G^T_Y	0.089	
G^B_X	0.131	$C^B_{Y\|X}$	0.098		G^B_Y	0.098	
					RE	0.098	
		V	0.102		**R**	0.004	
		V^W	0.054	53%	R^W	0.003	66%
		V^A	0.048	47%	R^A	0.001	34%
		V^T	0.015	15%			
		V^B	0.033	33%			

Table 10 further explores the vertical / Reynolds-Smolensky coefficient for the national-provincial and the cash-in kind decomposition of consolidated budget. The classification of income units into two groups does not change significantly the decomposition of progressiveness effects for national expenditures and taxes. There are, however, changes in average effects and individual effects across groups for provincial taxes and expenditures. The between-group effect of provincial taxes is regressive and is partially compensated by a progressive individual overlapping effect, just the opposite to the result found in the four-group classification. Also, the magnitude of transvariation effect of both provincial taxes and expenditures (both progressive) is small, implying that provincial budgets do not change the relationship between low-income units in financing jurisdictions and high-income units in beneficiary jurisdictions.

In the case of cash-in kind decomposition of the consolidated budget, results are also similar to those explained in Table 4. It is worth emphasizing that, by construction, the transvariation effect is low under this decomposition, which extends to sets of taxes and expenditures, with the exception of ex ante taxes ($t_{\times C}$).

Table 10. Group Contributors / Beneficiaries - personal distribution of income: Decomposition of the vertical – Reynolds Smolensky effect into within, between and transvariation components, 2010.

National - Provincial decomposition of RS					Cash-In Kind decomposition of RS				
	Full	W	T	B		Full	W	T	B
τ_N	0.303				$\tau_{\times C}$	0.104			
K_{tN}	-0.122	-0.066	0.008	-0.063	$K_{t\times C}$	-0.062	-0.036	0.066	-0.091
τ_P	0.084				$\tau_{\times E}$	0.283			
K_{tP}	-0.115	-0.069	0.026	-0.072	$K_{t\times E}$	-0.142	-0.078	-0.008	-0.056
γ_N	0.212				γ_C	0.122			
K_{gN}	0.250	0.134	0.011	0.105	K_{gC}	0.326	0.180	0.032	0.114
γ_P	0.176				γ_E	0.265			
K_{gP}	0.543	0.291	0.046	0.205	K_{gE}	0.409	0.217	0.025	0.167
V (RS)	0.102	0.054	0.015	0.033	V (RS)	0.102	0.054	0.015	0.033

Finally, Tables 11 and 12 repeat the previous exercises for regional distribution of income. The selection of groups does not change significantly the contribution of within-group (44 percent) and across-group (56 percent) to inequality (G_X = 0.267). We reach the same conclusion for the decomposition of across-groups inequality.

The selection of groups does not change the composition of the vertical effect (V = 0.036) into within- and across- groups either. But differences across group explain a higher proportion of the reranking effect (63 percent).

The decomposition of the across-group vertical effect also shows a different result. Differences on average incomes increase the inequality coefficient in 0.033, while individual differences of income units across groups slightly compensate it (-0.003). In other words, given a classification of financing-beneficiary provinces, the transvariation component of the vertical effect increases income differentials across groups.

Table 12 shows similar results to those discussed in Table 8. Three additional observations are in order. First, the reversion between K^T_{tP} (now positive) and K^B_{tP} (negative) found for personal income distribution is consistent under regional income distribution. Second, as said before, both within- and transvariation effects of fiscal policy are very low for regional income distribution. From an aggregate point of view, the vertical effect of consolidated budget is almost a proportional shifting of average income from the contributing group to the beneficiary group. Third, in the details, the progressive effect of provincial expenditure (in the first decomposition of budget) and in-kind expenditure (in the second decomposition of budget) is the net effect of progressive effects within groups and between groups, which are slightly compensated by a regressive effect across overlapping units of different groups.

Table 11. Group Contributors / Beneficiaries - regional distribution of income: decomposition of RE, V and R into within, between and transvariation components, 2010.

Regional distribution of income							
G_X	0.267	$C_{Y\|X}$	0.231		G_Y	0.235	
G^W_X	0.118	$C^W_{Y\|X}$	0.112		G^W_Y	0.113	
G^A_X	0.150	$C^A_{Y\|X}$	0.119		G^A_Y	0.122	
G^I_X	0.018	$C^I_{Y\|X}$	0.021		G^I_Y	0.023	
G^B_X	0.131	$C^B_{Y\|X}$	0.098		G^B_Y	0.098	
					RE	0.032	
		V	0.036		**R**	0.003	
		V^W	0.005	15%	R^W	0.001	37%
		V^A	0.030	85%	R^A	0.002	63%
		V^I	-0.003	-9%			
		V^B	0.033	93%			

Table 12. Group Contributors / Beneficiaries - regional distribution of income: Decomposition of the vertical – Reynolds Smolensky effect into within, between and transvariation components, 2010.

National - Provincial decomposition of RS					Cash-In Kind decomposition of RS				
	Full	W	T	B		Full	W	T	B
τ_N	0.303				$\tau_{\times C}$	0.104			
K_{tN}	-0.156	-0.079	-0.014	-0.063	$K_{t\times C}$	-0.209	-0.114	-0.005	-0.091
τ_P	0.084				$\tau_{\times E}$	0.283			
K_{tP}	-0.046	-0.033	0.059	-0.072	$K_{t\times E}$	-0.104	-0.053	0.005	-0.056
γ_N	0.212				γ_C	0.122			
K_{gN}	0.196	0.075	0.015	0.105	K_{gC}	0.224	0.100	0.009	0.114
γ_P	0.176				γ_E	0.265			
K_{gP}	0.256	0.092	-0.041	0.205	K_{gE}	0.223	0.075	-0.019	0.167
V (RS)	0.036	0.005	-0.003	0.033	V (RS)	0.036	0.005	-0.003	0.033

6. Conclusions

This paper reviews results from the literature on the effect of fiscal policy on income redistribution and provides a new decomposition of the redistributive effect of fiscal policy when individual units belong to identifiable groups. The developments in related papers (Cont and Porto, 2016a and 2017) constitute useful ground to apply the proposed measures to study the distributive impact of consolidated (nation-provinces) fiscal policy on personal and regional income distribution.

Section 2 discussed the contributions by the literature on (i) the decomposition of the redistribution effect between a vertical effect and a reranking effect (an horizontal effect is absent in this paper because the data does not have ex ante equal individual units), (ii) the

equivalence of the vertical effect and the Reynolds-Smolensky effect, (iii) the decomposition Reynolds-Smolensky coefficient of redistribution into size and progressive (Kakwani) effects, (iv) the decomposition of the Gini coefficient into within-group, between-group and transvariation effects, and (v) the decomposition of the reranking effect into within-group and across-group effects. The decomposition among within-group, between-group and transvariation effects in the presence of groups is extended to the vertical / Reynolds-Smolensky effect and to the progressiveness effect of the Reynolds-Smolensky coefficient.

Sections 3 and 4 apply decompositions of Gini, RE and RS in the presence of groups. Main results from these sections can be summarized as follows:

Personal income inequality in year 2010 (G_X = 0.512) is distributed among within-group (50 percent), differences in groups' average income (26 percent) and income overlapping of units belonging to different groups (23 percent). Income redistribution of consolidated fiscal policy (RE = 0.098) represents 19 percent of ex ante inequality). A vertical effect (V = 0.102) is partially compensated by reranking (R = 0.004).

When provinces and income units are clustered in groups according to socioeconomic indicators (Núñez Miñana), both vertical and reranking effects distribute within-group and across-group evenly. The vertical / Reynolds-Smolensky effect is also decomposed in three parts: In the case of national-provincial analysis fiscal policy, provincial expenditure is found to be the most progressive tool, reducing inequality within groups (53 percent of the progressive effect of provincial expenditure), reducing disparities between groups (19 percent) and reducing overlapping of income units (28 percent). National expenditure progressive effect and national taxes regressive effect distribute between within and between groups. They do not contribute to increase or reduce overlapping of income units. The impact of provincial taxes is regressive, as the net result of within and overlapping effects, partially compensated by a progressive effect between groups.

In the case of cash-in kind analysis fiscal policy, both kinds of expenditures are progressive and include a 50-percent within-effect. Cash transfers have little transvariation effect (cash benefits do not change relative net-incomes to overlapping units from different groups). In general, taxes are regressive in all dimensions, except for a progressive transvariation effect for ex-ante taxes (which partially compensates a regressive effect caused by higher taxes paid, in average, by income units belonging to poorer groups).

Regional income inequality in year 2010 (G_X = 0.267) is distributed among within-group (41 percent), differences in groups' average income (50 percent) and income overlapping of provinces belonging to different groups (9 percent). Income redistribution of consolidated fiscal policy (RE = 0.032) represents 12 percent of ex ante inequality). A vertical effect (V = 0.036) is partially compensated by reranking (R = 0.003).

Changes in average income between groups represent 72 percent of the across groups vertical effect. Reranking is mostly explained by narrowing of differences across groups. Within-group effects are small for both components of redistribution. Qualitative results from the decomposition of the Reynolds-Smolesnky effect are quite similar to those discussed for personal distribution of income. A first difference concerns the main factor of progressiveness of national and provincial expenditures: between-group effects are equal and within-group effects are weaker than those corresponding to personal income redistribution. A second difference is that taxes are regressive in all dimensions for both decompositions of fiscal policy (national-provincial and cash-in kind).

When provinces and income units are clustered in groups according to their situation regarding regional redistribution (i.e., whether they are beneficiaries or contributors), some new but expected differences arise. Considering personal distribution of income, the within-group effect weighs more in the Gini decomposition. As in the case of socioeconomic groups, the vertical effect is distributed within and across groups evenly, but differences in average income of both groups represent higher share of the across-groups effect. Changes within groups represent two thirds reranking. The decomposition of the Reynolds-Smolensky effect also illustrates some differences with respect to the socioeconomic classification: provincial taxes are regressive, as the result of within and between effects, which are partially compensated by a progressive overlapping effect; provincial budgets do not change the relationship between low-income units in financing jurisdictions and high-income units in beneficiary jurisdictions (i.e., transvariation effect is low at the provincial level).

Considering regional distribution of income, again, qualitative results are like those under the socioeconomic classification. We notice some individual differences notwithstanding: the transvariation component of the vertical effect increases income differentials across groups; differences across group explain a higher proportion of reranking; most of the vertical effect is explained by effects on average income of groups (between-group effect); provincial expenditure is progressive, but the tranvariation effect is regressive (a similar result hold for in kind expenditures); provincial taxes are regressive, but the transvariation effect is progressive (a similar result hold for ex post taxes).

The main lessons from decomposition of Gini, RE and RS coefficients are qualitatively the same for both group classifications selected in this paper, but each classification displays particular results. This may suggest a careful selection of groups. For example, whether transvariation vertical effects matter, whether overlaps matter for provincial taxes (in the national-provincial decomposition) or ex ante taxes (in the cash-in kind decomposition) as the effect is positive or negative depending on the selection of groups. Also, individual effects can be interpreted differently depending on the objective sought by the policy maker. For example, a progressive expenditure may hide regressive components (regional distribution of income, national-provincial decomposition; Table 12), or a regressive tax

may hide progressive sub-effects (personal distribution of income, cash-in kind decomposition; Table 6).

The findings of this paper may also be useful for the design of fiscal policy in a federal country like Argentina when the objectives are efficiency and equity, both in static and dynamic terms. Considering provinces as units there are several potential fields of improvement. a) Rebalancing the distribution of expenditures between nation and provinces: Among provincial expenditures the provision of goods like education, justice, health and police are predominant (86% of the total in 2010) with higher distributive impact than national transfers, which are the predominant national expenditures (70% in 2010). It is interesting to note that the share of provincial expenditures was 47% in 1995, 43% in 2010 and 39% in 2016, displaying a clear tendency to centralization. b) Redesign of the tax system. As an example, if taxes were proportional ($K_{tN} = K_{tP} = 0$) income distribution would improve 0.05 (9%-reduction in the Gini coefficient). c) Tax regressiveness and expenditure size. A change in the tax system (from regressive to proportional) could be accompanied by a decrease the size of public expenditures, for a given redistributive effect. This is relevant since expenditures had a sizeable growth between 2002-2004 and 2010 (from 27% to 40% of GDP). This policy would enhance efficiency –due to less taxation– without loss of equity to the extent that the progressivity of expenditures increases so as to compensate the reduction in size. d) Fiscal correspondence. A possible reform could involve a reallocation of expenditures responsibilities among different levels of governments. In 2010, provinces' share in the consolidated expenditures was 45% while their share in revenue was 22%. Second-generation fiscal federalism theories study the relationship between economic growth and the federal model that allows a proper functioning of markets, emphasizing the importance of self-financing at the local level. A necessary condition for efficient provision of local goods is that they also collect a high share of local taxes (this is the "Wicksellian connection"). The cost of aligning provincial revenues and expenditures is a possible forsake of equity, so this trade-off should be considered. e) Room to improve income distribution through rebalancing expenditure from cash transfers to in kind expenditures. At the consolidate level, Kakwani indexes of progressivity are 0.409 and 0.326 respectively. In addition, transfers may create dependency of the recipient, both financial and political, thus creating risks of clientelism. On the other hand, cash transfers are not the strongest redistributive tool because they are assigned to current consumption that benefit a person or a family; instead, in-kind expenditures (education, health, water, house, etc.) benefit a community for a long period. Cash transfers can be justified on certain grounds and times (like in the Argentina crisis of 2002).

Appendix A

A.1. Decomposition of Gini coefficients

In this Appendix we describe the Gini and concentration indexes used throughout the paper. Let $X=\{x_i\}$ and $Y=\{y_i\}$ be two income distributions. The Gini coefficient for a distribution, say X, is presented in three different versions

$$G_X = \begin{cases} \dfrac{1}{2\mu_X}\sum_{i=1}^{N}\sum_{j=1}^{N}|x_i - x_j|.p_i.p_j \\ \dfrac{1}{\mu_X}\sum_{i=1}^{N}\sum_{j=1}^{N}max\{0; x_i - x_j\}.p_i.p_j \\ \dfrac{1}{2\mu_X}\sum_{i=1}^{N}\sum_{j=1}^{N}(x_i - x_j).p_i.p_j.I\{r_X(x_i) - r_X(x_j)\} \end{cases}$$

where p_i is the (population) weight of income unit i and μ_X is the average income corresponding to distribution X. The indicator function $I\{r_X(x_i) - r_X(x_j)\} = I^X_{i\text{-}j}$ is such that

$$I(h) = \begin{cases} 1\ if\ h \geq 0 \\ -1\ if\ h < 0 \end{cases}$$

These are three definitions among a long list of alternative definitions of the Gini coefficient of inequality.

Consider the case of a population partitioned in S groups, ordered according to average income within groups ($s>r$ iff $\mu_{X,s} > \mu_{X,r}$). The Gini coefficient for distribution X can be decomposed into three effects:

$$G_X = G_X^W + G_X^A = G_X^W + G_X^T + G_X^B$$

where G_X^W is a *within-group* component, G_X^T stands for a *transvariation / overlapping*, G_X^B is a *between-groups* component, and G_X^A corresponds to an *across-groups* component (which is the sum of the between and overlapping effects).

There are several representations of the components. For convenience, we illustrate the decomposition followed by Dagum (1997) and Monti et al. (2012):[17]

$$G_X^W = \frac{1}{2\mu_X}\sum_{s=1}^{S}\left[\sum_{l=1}^{N_s}\sum_{m=1}^{N_s}(x_{l,s} - x_{m,s}).p_{l,s}.p_{m,s}.I^X_{l,s-m,s}\right]$$

$$G_X^T = \frac{1}{\mu_X}\sum_{s=2}^{S}\sum_{r=1}^{s-1}\left[2\sum_{l=1}^{N_s}\sum_{\substack{m=1 \\ \{x_{l,s}<x_{m,r}\}}}^{N_r}(x_{m,r} - x_{l,s}).p_{l,s}.p_{m,r}\right]$$

[17] Alternative representations can be obtained from Bhattacharya-Mahalanobis (1967) and Pyatt (1976), also used by Dieguez and Petrecolla (1978) and Cont and Porto (1998).

The G_X^T component is calculated after sorting groups s in increasing order of average income ($\mu_{X,S}$), so that it adds all income differentials such that $\mu_{X,s} > \mu_{X,r}$ and $x_{m,r} > x_{l,s}$ (see that first sum goes from $s=2$ to S, and the second sum goes from $r=1$ to $s-1$). As with the Pyatt decomposition, $G_X^T=0$ if $\min\{x_{l,s}\} > \max\{x_{m,r}\}$ for all pairs of groups.

Finally,

$$G_X^B = \frac{1}{\mu_X}\sum_{s=2}^{S}\sum_{r=1}^{s-1}(\mu_{X,s} - \mu_{X,r}).p_s.p_r = \frac{1}{\mu_X}\sum_{s=2}^{S}\sum_{r=1}^{s-1}\left[\sum_{l=1}^{N_s}\sum_{m=1}^{N_r}(x_{m,r} - x_{l,s}).p_{l,s}.p_{m,r}\right]$$

and hence

$$G_X^A = \frac{1}{2\mu_X}\sum_{s=1}^{S}\sum_{r\neq s}\left[\sum_{l=1}^{N_s}\sum_{m=1}^{N_r}(x_{l,s} - x_{m,r}).p_{l,s}.p_{m,r}.I_{l,s-m,s}^{X}\right]$$

The same definitions apply to the Gini coefficient corresponding to the Y distribution.

A.2. Decomposition of concentration coefficients

Monti et al. (2012) also show that the concentration coefficient of Y distribution, while preserving the ordering from the X distribution, is:

$$C_{Y|X} = \frac{1}{2\mu_Y}\sum_{i=1}^{N}\sum_{j=1}^{N}(y_i - y_j)p_i p_j.I_{i-j}^{Y|X}$$

where the indicator function $I(h)$ previously defined applies to the ordering $Y|X$ (i.e., the values y_i are ordered according to increasing values of x_i, and the indicator $I_{i-j}^{Y|X}$ takes value of 1 if $x_i \geq x_j$). The difference between G_Y and $C_{Y|X}$ arises when $x_i > x_j$ and $y_i < y_j$ (or vice-versa). The authors show that $C_{Y|X}$ can be decomposed in within- and across- effects:

$$C_{Y|X} = C_{Y|X}^W + C_{Y|X}^A$$

where

$$C_{Y|X}^W = \frac{1}{2\mu_Y}\sum_{s=1}^{S}\left[\sum_{l=1}^{N_s}\sum_{m=1}^{N_s}(y_{l,s} - y_{m,s}).p_{l,s}.p_{m,s}.I_{l,s-m,s}^{Y|X}\right]$$

$$C_{Y|X}^A = \frac{1}{2\mu_Y}\sum_{s=1}^{S}\sum_{r\neq s}\left[\sum_{l=1}^{N_s}\sum_{m=1}^{N_r}(y_{l,s} - y_{m,r}).p_{l,s}.p_{m,r}.I_{l,s-m,r}^{Y|X}\right]$$

This way, reranking ($R = G_Y - C_{Y|X}$) can be decomposed into $R^W = G_Y^W - C_{Y|X}^W$ and $R^A = G_Y^A - C_{Y|X}^A$. Even though $C_{Y|X}^A$ can be decomposed into $C_{Y|X}^B$ and $C_{Y|X}^T$, Monti et al.

(2012) show that $R^T = G_Y^T - C_{Y|X}^T$ and $R^B = G_Y^B - C_{Y|X}^B$ are not proper measures of reranking.

A.3. Proof of Proposition 1

In Section A.2 of this Appendix we stated that Monti et al. (2012) showed that $C_{Y|X} = C_{Y|X}^W + C_{Y|X}^T + C_{Y|X}^B$. Now take another distribution, say *Z*, such that groups are ordered according to a non-decreasing order of the mean $\mu_{X,s}$, and values z_i are lined up in non-decreasing ordering of x_i within each group *s*. The concentration coefficient $C_{Z|X}$ of *Z* distribution, while preserving the ordering from the *X* distribution, is:

$$C_{Z|X} = \frac{1}{2\mu_Z}\sum_{i=1}^{N}\sum_{j=1}^{N}(z_i - z_j)p_i p_j . I_{i-j}^{Z|X}$$

where μ_Z is the average of variable z_i and

$$I_{i-j}^{Z|X} = I\{r_Z(z_i) - r_Z(z_j)\}, \text{ where } I(h) = \begin{cases} 1\ if\ h \geq 0 \\ -1\ if\ h < 0 \end{cases}$$

It is straightforward to extend the decomposition of $C_{Z|X}$ as:

$$C_{Z|X} = C_{Z|X}^W + C_{Z|X}^A = C_{Z|X}^W + C_{Z|X}^B + C_{Z|X}^T$$

where

$$C_{Z|X}^W = \frac{1}{2\mu_Z}\sum_{s=1}^{S}\left[\sum_{l=1}^{N_s}\sum_{m=1}^{N_s}(z_{l,s} - z_{m,s}).p_{l,s}.p_{m,s}.I_{l,s-m,s}^{Z|X}\right]$$

$$C_{Z|X}^A = \frac{1}{2\mu_Z}\sum_{s=1}^{S}\sum_{r\neq s}\left[\sum_{l=1}^{N_s}\sum_{m=1}^{N_r}(z_{l,s} - z_{m,r}).p_{l,s}.p_{m,r}.I_{l,s-m,r}^{Z|X}\right]$$

$$G_{Z|X}^B = \frac{1}{\mu_Z}\sum_{s=2}^{S}\sum_{r=1}^{s-1}(\mu_{Z,s} - \mu_{Z,r}).p_s.p_r$$

$$C_{Z|X}^T = \frac{1}{\mu_Z}\sum_{s=2}^{S}\sum_{r=1}^{s-1}\left[2\sum_{l=1}^{N_s}\sum_{\substack{m=1 \\ \{x_{l,s}<x_{m,r}\}}}^{N_r}(z_{m,r} - z_{l,s}).p_{l,s}.p_{m,r}\right]$$

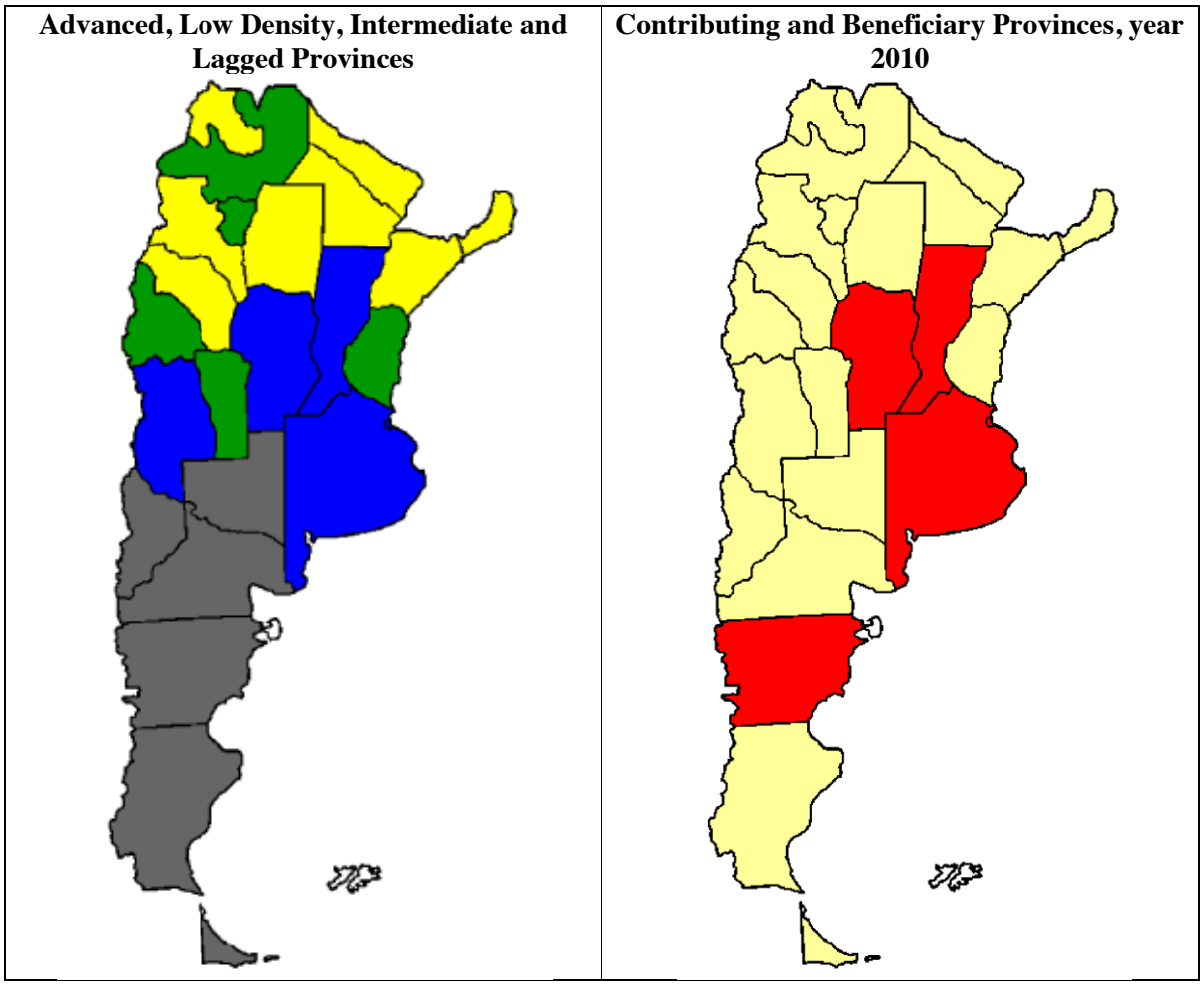
Appendix B

Table B1. Regional indicators, 2010

Jurisdiction	Group	Surface (sq km)	Population ('000)	Population density	GGP (million dollars)	Per capita GGP ('000 dollars)	Extended per capita GGP ('000 dollars)	HDI (2011)	UBN
Buenos Aires	A	307,571	15,316	49.8	130,332	8,510	8,116	0.84	8%
City Bs As	A	200	3,058	15291.5	84,128	27,508	26,953	0.89	6%
Catamarca	L	102,602	404	3.9	3,253	8,047	9,075	0.84	11%
Chaco	L	99,633	1,071	10.8	4,117	3,844	5,135	0.81	18%
Chubut	LD	224,686	471	2.1	5,854	12,436	11,292	0.85	8%
Córdoba	A	165,321	3,397	20.5	26,671	7,852	7,567	0.86	6%
Corrientes	L	88,199	1,036	11.7	4,259	4,112	4,721	0.83	15%
Entre Ríos	I	78,781	1,282	16.3	7,861	6,132	6,671	0.84	8%
Formosa	L	72,066	556	7.7	1,919	3,453	5,522	0.81	20%
Jujuy	L	53,219	698	13.1	3,089	4,422	5,609	0.83	15%
La Pampa	LD	143,440	341	2.4	1,823	5,338	6,704	0.86	4%
La Rioja	L	89,680	355	4.0	1,526	4,294	6,783	0.83	12%
Mendoza	A	148,827	1,766	11.9	12,282	6,956	7,181	0.85	8%
Misiones	L	29,801	1,111	37.3	7,402	6,660	7,199	0.82	16%
Neuquén	LD	94,078	565	6.0	7,780	13,764	14,249	0.86	10%
Río Negro	LD	203,013	604	3.0	4,790	7,933	9,066	0.85	9%
Salta	I	155,488	1,267	8.2	5,006	3,950	4,255	0.83	19%
San Juan	I	89,651	715	8.0	3,293	4,605	5,102	0.83	10%
San Luis	I	76,748	457	6.0	3,020	6,611	8,010	0.83	8%
Santa Cruz	LD	243,943	234	1.0	3,767	16,092	16,444	0.87	8%
Santa Fe	A	133,007	3,285	24.7	32,966	10,035	9,204	0.85	6%
S. del Estero	L	136,351	884	6.5	3,340	3,781	5,226	0.81	18%
Tierra del Fuego	LD	21,571	134	6.2	2,551	19,081	19,381	0.88	14%
Tucumán	I	22,524	1,512	67.1	6,615	4,377	5,109	0.84	13%
Argentina		**2,780,400**	**40,519**	**14.6**	**367,643**	**9,073**	**9,082**	**0.85**	**9%**
(std. deviation)						0.64	0.59	0.03	0.51

Source: own elaboration based on INDEC Argentina (surface, population, and UBN - Unsatisfied Basic Needs), and United Nations (HDI - Human Development Index). GGP published by Council of Federal Investment (CFI) until 2006 and then updated by regional drivers, and expanded to the GDP using national accounts, with base 1993 (the government updated statistics in 2014, from base 1993 to base 2004; we maintain the base-1993 statistics because they are consistent with the data base of companion papers). Note: A: Advanced; I: Intermediate; LD: Low Density; L: Lagged. The exchange rate was 3.93 Argentine pesos per dollar in year 2010.

Figure B1. Selected groups of provinces



Source: Left Panel from Table B1 and footnote 15. Blue: Advanced; Grey: Low Density; Green: Intermediate; Yellow: Lagged. Right Panel from own elaboration based on results. Red: contributors; Light yellow: beneficiaries.

References

Ahumada, H., Canavese, A., Gasparini, L., Porto, A. and Sanguinetti, P. (1996). "Impacto distributivo del presupuesto público. Aspectos Metodológicos", Serie Política Fiscal 77, CEPAL.

Atkinson, A.B. (1980). Horizontal equity and the distribution of the tax burden. In H.J. Aaron and M.J. Boskins (eds.) *The Economics of Taxation*. Washington D.C.: Brookings.

Aronson, J., Johnson, P. and Lambert, P. (1994). "Redistributive effect and unequal income tax treatment", *Economic Journal*, 104(423): 262-270.

Aronson, J. and Lambert, P. (1994). "Decomposing the Gini coefficient to reveal vertical, horizontal and reranking effects of income taxation", *National Tax Journal*, 47(2): 273-294.

Bhattacharya, N. and Mahalanobis, B. (1967). "Regional disparities in household consumption in India", *Journal of the American Statistical Association*, 62(317): 143-161.

Cont, W. and Porto, A. (2014). "Personal and regional redistribution through public finance in a federal setting", The *Quarterly Review of Economics and Finance*, 54, 563-578.

Cont, W., and Porto, A. (2016a). "Fiscal policy and income distribution. Argentina 1995 - 2010", *Review of Economics & Finance*, 6(2): 75-92.

Cont, W. and Porto, A. (2016b). "Geografía de la desigualdad en la distribución personal del ingreso y en el impacto distributivo de la política fiscal. Argentina 1995-2010", LI Reunión Anual de la Asociación Argentina de Economía Política, Tucumán.

Cont, W. and Porto, A. (2017), "Geografía de la distribución del ingreso y del impacto distributivo de la política fiscal. Argentina 1995-2010. Cuantificación de variables por jurisdicciones. Datos y metodología". Document in Spanish, available here.

Cont, W., Porto, A. and Juarros, P. (2017). "Regional income redistribution and risk-sharing: Lessons from Argentina", *Journal of Applied Economics*, 20(2): 241-269.

Cubel, M. (2014). "Fiscal equalization and political conflict", in Warneryd, K. (ed.), *The economic conflict: theory and empirical evidence*, CESinfo Seminar Series, The MIT Press, 23-39.

Dagum, C. (1997): "A new decomposition of the Gini Income Inequality Ratio", *Empirical Economics*, 22: pp. 515-531.

Deaton, A. (1996). *The analysis of household surveys: A microeconometric approach to development policy*, Johns Hopkins University Press.

Dieguez, H. y Petrecolla A. (1979): "Distribución del ingreso en el Gran Buenos Aires", *Serie Economía*, Instituto Torcuato Di Tella, Buenos Aires.

Duclos, J. (1993). "Progressivity, redistribution and equity, with application to the British Tax and Benefit system", *Public Finance*, 48(3): 350-365.

Duclos J., Jalbert, V. and Araar, A. (2003). "Classical horizontal inequality and reranking: an integrating approach", in Amiel, Y. and Bishop J. (eds.), *Fiscal Policy, Inequality and Welfare (Research on Economic Inequality, Volume 10)*, Emerald Group Publishing Limited, 65-100.

Feldstein, M. (1976). "On the theory of tax reform", *Journal of Public Economics*, 6(1-2): 77-104.

Griffiths, W. (2008). "On Dagum's Decomposition of the Gini Coefficient", The University of Melbourne Department of Economics, Research Paper Number 1054.

Jenkins, S. (1988). "Reranking and the analysis of income redistribution", *Scottish Journal of Political Economy*, 35(1): 65-76.

Kakwani, N. (1977). "Measurement of tax progressivity: an international comparison", *Economic Journal*, vol. 87, pp. 71-80.

Kakwani, N. (1984). "On the measurement of tax progressivity and redistributive effect of taxes with applications to horizontal and vertical equity". *Advances in Econometrics*, vol. 3, pp. 149-168.

Kakwani, N. (1986). *Analyzing Redistribution Policies*. Cambridge: University Press.

Kim, K. and Lambert, P. (2009). "Redistributive effect of U.S. taxes and public transfers, 1994-2004", *Public Finance Review*, 37: 3-26.

King, M. (1983). "An index of inequality: With implications to horizontal equity and social Mobility", *Econometrica*, 51(1): 99-115.

Lambert, P. (1985). "On the redistributive effect of taxes and benefits", *Scottish Journal of Political Economy*, 32(1): 39-54.

Lambert, P. (1988). "Net fiscal incidence progressivity: some approaches to measurement" in Eichhorn, W. (ed.), *Measurement in Economics: Theory and Applications of Economic Indices*, pp. 519-532. Heidelberg: Physica-Verlag.

Lambert, P., and Aronson, R. (1993). "Inequality Decomposition Analysis and the Gini Coefficient Revisited", *The Economic Journal*, 103: 1221-1227.

Lerman, R. I., Yitzhaki, S., 1995, Changing ranks and the inequality impacts of taxes and transfers, *National Tax Journal*, 48(1), 45-59.

Monti, M., Mussini, M. and Vernizzi, A. (2012). "The Decomposition of the Atkinson-Plotnick-Kakwani Re-Ranking Measure", *Statistica applicata - Italian Journal of Applied Statistics*, 22: 177-198.

Mookherjee, D. and Shorrocks, A. (1982). "A decomposition analysis of the trend in U.K. income inequality", *Economic Journal*, 92: 886-902.

Monti, M. (2007). "A note on the Dagum decomposition of the Gini inequality index", DEAS Università degli studi di Milano, WP 2007-16.

Musgrave, R. (1964). "Estimating the distribution of the tax burden", in Clark, C. and Stuvel, G. (eds.), *Income redistribution and the statistical foundations of economic policy, income and wealth*, Bowes and Bowes, Cambridge.

Musgrave, R. (1996). "The role of the state in fiscal theory", *International Tax and Public Finance*, 3: 247-258.

Musgrave, R. and Thin, T. (1948). "Income tax progression, 1929-48", *Journal of Political Economy*, 56(6): 498-514.

Nuñez Miñana, H. (1972). "Indicadores de Desarrollo Regional en la República Argentina: Resultados Preliminares", Documento Interno Nº 10 del Instituto de Investigaciones Económicas, Universidad Nacional de La Plata. Republished in: Porto, A. (ed). *Finanzas Públicas y Economía Espacial*. Universidad Nacional de La Plata (1995). Pp. 11-24.

Oates, W. E. (1972): *Fiscal Federalism,* Harcourt Brace Jovanovich, Inc., USA; and E. Elgart,2011, UK.

Pfähler, Willem (1987), "Redistributive Effects of Tax Progressivity: Evaluating a General Class of Aggregate Measures", *Public Finance/ Finances Publiques*, 42: 1-31.

Plotnick, R. (1981). "A measure of horizontal inequity", *Review of Economics and Statistics*, 63: 283-288.

Porto, A. y Cont W. (1998): "Presupuestos provinciales, transferencias intergubernamentales y equidad", *Desarrollo Económico,* 38, Special Issue, pp. 267-291.

Porto, A. (2017). "Transferencias intergubernamentales, igualación fiscal y reordenamiento de las provincias", 52 Annual Meeting of *Asociación Argentina de Economía Política*.

Pyatt, G. (1976). "The interpretation and disaggregation of Gini coefficients", *The Economic Journal*, 86: 243-255.

Reynolds, M. and Smolensky E. (1977): *Public Expenditures, Taxes and the Distribution of Income,* American Press, New York.

Schiller, B. (1977). "Relative Earnings Mobility in the United States", *American Economic Review*, 67(5): 926-941.

Silber, J. (1989). "Factor components, population subgroups and the computation of the Gini index of inequality", *Review of Economics and Statistics*, 71: 107-15.

Urban, I. (2009a). "Indices of redistributive effect and reranking: Reinterpretation", ECINEQ WP 2009 – 147.

Urban, I. (2009b). "Kakwani decomposition of redistributive effect: Origins, critics and upgrades", ECINEQ WP 2009 – 148.

Urban, I. and Lambert, P. (2008). "Redistribution, horizontal inequity and reranking: how to measure them properly", *Public Finance Review*, 36(5): 563-587.

van de Ven, J., J. Creedy and P.J. Lambert (2001). "Close equals and calculation of the vertical, horizontal and reranking effects of taxation", *Oxford Bulletin of Economics and Statistics*, 63: 381-394.

Wagstaff, A. (2009). "Re-ranking and pro-poor growth: decompositions for China and Vietnam", *Journal of Development Studies*, 45(9): 1403-1425.