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Service Provision in Unequal Democracies: Evidence from Brazil on How the Poor Get Shortchanged

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Service Provision in Unequal Democracies: Evidence from Brazil on How the Poor Get Shortchanged

A dissertation submitted in partial satisfaction
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by

Marika Danielle Csapo

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Abstract of the Dissertation

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Marika Danielle Csapo

Doctor of Philosophy in Political Science

University of California, Los Angeles, 2016

Professor Barbara Geddes, Chair

This dissertation addresses a consistent empirical challenge to the predictions of democratic theory: the poor, despite being enfranchised and numerous, often fail to secure public provision of services they demand. Traditional explanations suggest that either the poor do not actually demand such services, or more likely, they find themselves unable to hold elected politicians accountable for service provision. In this dissertation, I propose a new mechanism that could underlie constrained accountability. I show that even when the poor demand services, turn out to vote, and vote their interests, they may still be disadvantaged in service provision in democracy under certain circumstances. In particular, they will be disadvantaged if their service interests are diffuse across various service categories while wealthier individuals have more concentrated service demands. This is most likely when the demands of the poor differ greatly from the demands of the wealthy, which I expect to be most common in highly unequal societies. In Chapter 2, I present a mathematical model that demonstrates the logic of my argument. Typical democratic accountability arguments suggest that groups' policy representation should be weighted proportionally to the size of the group, assuming all groups turn out to vote at equal rates and possess the same information. My model confirms this logic, but highlights a mediating factor: group weight in policy representation is also governed by the concentration of service demands for the group, compared to the concentration of other groups' demands. Chapters 3 and 4 attempt to address various implications of the argument in a real setting. I focus on the provision of primary care and

hospital services in a single decentralized democracy, Brazil, to hold democratic institutions constant. In Chapter 3, I use original survey data to show that the poor in Brazil prefer more municipal spending on public primary care, while the better-off prefer spending on hospitals. I also show that a conditional cash transfer program (*Bolsa Família*) that decreases the dependence of poor recipients on public primary care provision serves to shift the preferences of this group toward hospital care and to increase recipients' responsiveness to service spending by concentrating service demands on their preferred service. In Chapter 4, I turn to the macro-implications of the model, showing that *Bolsa Família* is, indeed, associated with decreases in public spending on primary care services at the municipal level. The chapter shows that municipal funds follow the shifting preferences of transfer-recipients, toward hospital care. I show that the shift seems to be the result not just of a growth in group size for voters that prefer hospital spending, but also results from increased policy influence for the recipient group whose preferences become more concentrated on hospital care than they previously were on primary care. Finally, Chapter 5 addresses the welfare implications of this research. It shows that there are consequences for the infant rates of the non-recipient poor following the decrease in spending on public primary care clinics shown to be associated with *Bolsa Família*.

The dissertation of Marika Danielle Csapo is approved.

Michael Thies

Rick Wilson

Michael Ross

Barbara Geddes, Committee Chair

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2016

To Mako and Joe

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CHAPTER 1

Introduction

On a Saturday afternoon in Domingos Martins, Espírito Santo, Brazil, a woman peddling meat skewers outside a *lanchonete* (a shack with a pool table selling an assortment of fried foods and watery beer) pointed me across the street to the local public health clinic, which was closed for the weekend. The clinic is great on weekdays, she explained. But they close at four o'clock. When I asked what she would do if she got sick in the evening or over the weekend, she said she would hope to find someone in the community with a car to drive her to get treatment in one of the neighboring municipalities—the closest option available. She joked that the only other option was to have her neighbor put her in a wheelbarrow and run. Calling someone from the office of the Secretary of Health in her municipality would, in theory, have been an option, but she does not have a phone. Nor do her neighbors. If she did manage to call, she explained, it would take so long to get transportation that she might as well just wait for the clinic to open. This was a rosier story than I was used to. Her clinic was not plagued by the long waits or lack of basic materials like prescription pads that many are. And, apparently, in her small town the neighbors would go to great lengths for each other to pick up the slack of the state.

It has been over 30 years since Brazil's return to popular democracy. The new Constitution idealistically promises access to universal state-provided health care. Public health services in richer parts of the country are top-notch and cutting-edge. So why is the well-being of the poor still so dependent on the kindness of neighbors? My research asks why poor voters in Brazil are unable to impose their public health service spending preferences, despite their numerical advantage in voting.

Much political science literature is dedicated to understanding patterns of distribution

of material resources and services in the public domain. Classical models of distribution often rely on spatial or directional analysis of ideological proximity between political actors (Hotelling, 1929; Black et al., 1958; Enelow and Hinich, 1984; Rabinowitz and Macdonald, 1989). The assumption that ideology structures politics affords the researcher considerable analytical leverage. It superimposes a logical structure to individual preferences from which the researcher can derive individual demands and coalitions likely to form in different configurations of electoral institutions.

However, many—perhaps a majority—of democratic countries have elections that are only weakly structured by ideology by on-the-ground accounts. Generally, newer, poorer and less equal democracies tend to have elections that are less ideologically coherent. Empirical descriptions of both politicians' choices about how to appeal to voters and voters' choices about who to vote for often emphasize the trade of material or policy resources for votes (Wantchekon, 2003; Stokes, 2005; Schaffer, 2007; Díaz-Cayeros, Estévez and Magaloni, 2012; Finan and Schechter, 2012). It is precisely in this less programmatic context where targeted distribution should be most electorally relevant. My research contributes to the understanding of distributive politics by showing formally and empirically that conceptualizing the competitive political arena as one of electoral trade leads to predictions that voters with more diverse policy and material needs are systematically less well represented in distribution dynamics than voters with less diffuse demands.

My research makes several contributions to understanding distributive politics in this context. First, as a theoretical contribution, I provide a logical extension of the tactical spending (vote-trading) rationale associated with Dixit and Londregan (1996). In a tactical spending context, a voter's marginal responsiveness to a policy shift is what the elected politician cares about. We therefore ought to know more about which factors govern voter responsiveness to spending[1] if we want to be able to predict (or manipulate) patterns of distribution. I contribute a formal argument offering a novel insight—the plurality of voters' needs influences voters' marginal response rates and therefore, mediates the appeal of their

[1]Technically, this might be best described as a voter's marginal rate of substitution with respect to alternative policies.

demands to elected politicians trying to figure out how best to use scarce resources to improve their election prospects.

Second, the empirical chapters of my dissertation illustrate and support the argument by showing how it operates in a concrete case. I show that a flagship transfer program in Brazil (*Bolsa Família*) meant, in part, to improve the health of poor program recipients has negative spillover effects on the health of poor non-recipients of the program, as measured by infant mortality rates. I show that this is because pro-poor health services receive decreased investments as the needs of the poor become more diffuse in association with noisy application of the transfer program. While the argument helps to make sense of these findings, empirically documenting the contradiction itself is a novel contribution to the development and program evaluation literature. The chapter further draws attention to the importance of considering spillover effects in program evaluation for those interested in a program's contribution to overall development.

Third, my dissertation makes a contribution to the area-specific understanding of voting behavior in Brazil. My survey work confirms the findings of recent scholarship that ideology is important to Brazilian voting behavior for only a small subset of voters (Samuels and Zucco, 2014). I further shine light on exactly how health care, an issue that much Brazilian public opinion research already suggests is electorally important, has been relevant to elections in Brazil. My dissertation clarifies which groups vote for which health services and which of those services seem to be especially relevant to electoral politics.

1.1 Models of Distribution

From a policy-predictive standpoint, political scientists know relatively little about how politics functions in democratic countries with less programmatic party alignments and policy agendas. We have detailed statistical and mathematical models to help us understand how politics functions in more ideological party settings (Black et al., 1958; Persson and Tabellini, 2002; Poole and Rosenthal, 2007). In this context, if we understand the party institutions and party ideologies we can predict policy outcomes—and we can do this without having to

characterize the entire distribution of policy demands across voters.

In places with less programmatic politics, we also have models of electoral strategies—in particular, clientelism or constituent politics (Cox and McCubbins, 1986; Stokes, 2005; Díaz-Cayeros, Estévez and Magaloni, 2012; Nichter, 2008) and tactical distribution (Dixit and Londregan, 1996). The literature that deals with settings of institutionalized mass partisanship (as in the analysis of clientelism and constituent politics) may succeed at predicting distribution patterns by partisanship, even if the distribution is not ideological. However, in the absence of a consistent electoral constituency in the less programmatic context, we are often limited to a discussion of the mechanism of distribution, without being able to extrapolate to generalizations about policy outcomes. The mechanism, tactical spending, is thought to be driven by competitive candidates optimizing (expected) marginal vote returns to a policy shift (Dixit and Londregan, 1996). It is difficult to systematically predict what groups will benefit from tactical spending without being able to rely on ideology or partisanship from which to infer voters' priorities.

In this context, political scientists often try to predict policy demands based on income as a substitute for ideology. The field has developed various theories of economic voting (Meltzer and Richard, 1981; Fiorina, 1981; Acemoglu and Robinson, 2000). This assumption buys us an income-based intuition about voter response rates to distributed resources. For example, some scholars argue that the votes of the poor are cheaper to buy than the votes of the wealthy (Stokes, 2005). There is some evidence for this. In Brazil the poorer parts of the country are generally more likely to vote in favor of incumbents, regardless of the incumbent's ideology (Zucco, 2008). On the other hand, it may be that the poor are so easy to buy off that they exhaust their responsiveness on goods needed for basic survival, and so are less sensitive to policy shifts less immediately identified with survival. It remains unclear, then, whether income is a reasonable proxy for ideology, especially outside of more developed countries. Even if it is, we do not know whether this dimension can be characterized as the dominant operating system governing voting behavior. After all, in Brazil, poor regions of the country have had a history of voting more conservatively than industrialized parts of the country until recently (Zucco, 2008).

What else describes policy-making in less programmatic democracies? This dissertation shows that those groups with multiple policy demands will receive less policy weight than a comparably-sized group with fewer policy demands in democracy. Though I will focus my case study of health care policy in Brazil on an income-related dimension, the argument is generalizable to any case where there is reason to believe that one group's policy demands are more diffuse than that of another group's. In this case, income is a proxy for the diversity of demands in a specific sector, rather than an ideological proxy. Any dimension (say, for example, ethnic diversity) that proxies for plurality of demands would be equally useful.

1.2 Plan of the Dissertation

This dissertation quantitatively traces the logic of the argument through its micro- and macro-implications. I move from a formalization of the argument (Chapter 2), to the empirical application in terms of microfoundations in Brazil (Chapter 3), to the public spending implications of the argument in Brazil (Chapter 4), to the overall ramifications of this logical chain on development outcomes (Chapter 5). In Chapter 1, I introduce the problem and broadly locate the argument within the literature.

In Chapter 2, I develop the argument and provide a more detailed discussion of how it builds on and contributes to previous scholarship. I address an inconsistency in the literature that uses income to proxy for redistributive demands, contrasting theoretical expectations that the poor will have high voting leverage in democracies with the empirical fact that democracy is often an insufficient condition to promote the welfare of the poor. Existing explanations of the theoretical failure include a lack of demand for redistribution by the poor and the inability of the poor to hold elected politicians accountable. I formalize a model that adds a new and more general argument to the debate: vote-maximizing politicians will put less weight in spending allocation decisions on the preferences of voters whose demands are more evenly divided across many services. This is because the votes of groups with more asymmetric preferences over services competing for a budget are more responsive to shifts in spending between these services. Intuitively, when voters pile the weight of their votes

on fewer services, they have more voting influence than those that must split the weight of their votes across multiple services. In practical terms, where politicians rely on tactical spending strategies the preferences of those voters with greater state dependence will receive less weight in spending allocation decisions than do those with lower levels of dependence on public services when the less dependent group relies on fewer services.

Chapter 3 explains why I test this argument in Brazil and clarifies the research design. Municipal health services in Brazil provide a case study to test my argument. Since municipal governments in Brazil must divide a single health budget between various class-identified health services, this empirical setting provides a parallel to my formal model setup. I use original survey data to show that the poor have more symmetrical preferences over the various health services than do the better-off. Using data on electoral choice from the survey, I then show that the votes of the group with more symmetrical health preferences (i.e., the poor) are less responsive to changes in the allocation of the health budget to different health services, as the model implies. I provide an additional test of the argument by looking within the poor group at how a program that provides an upward shock to the income of poor, treated families (*Bolsa Família*) changes the responsiveness of the treated group to health spending. The income shock decreases state dependence on primary care services among the treated poor (though not on hospital services), making that group's preferences relatively more asymmetrical compared to the untreated poor. I use the survey data to show the resulting increase in asymmetry increases the responsiveness of the treated poor to health spending. The model suggests, then, that the income shock should precipitate municipal shifts in health spending, favoring the preferences of the treated poor, thus weakening the influence of the untreated poor.

Chapter 4 tests these spending implications of the model. As predicted, municipal assignment of *Bolsa Família* is associated with the subsequent transfer of public health funds away from services preferred by the untreated poor group (with more symmetrical service preferences) and toward those services preferred by the treated group (with less symmetrical preferences). That is, at the municipal level *Bolsa Família* decreases the voting power of the untreated poor on the mayor's health spending allocation, while increasing the influence

of the treated. I show not only that the Program is correlated with the predicted shifts in municipal health care spending allocation, but also that the larger the coverage of the program in a municipality, the greater the size of the effect. I use mediated regression to show that the shift in spending away from primary care services has an real service-reducing effect (and so, is not simply capturing improved efficiency of service provision).

Chapter 5 identifies and documents a public policy paradox in Brazil: the initiation of a federal program (*Bolsa Família*) meant to empower poor recipients by improving their baseline health turns out to be correlated at the municipal level with *worsening* infant mortality rates over time, relative to municipalities with the same target- but lower observed-assignment rates. I use individual data to parse this result into the effects of the federal transfer program on the recipient (treated) poor and the non-recipient (untreated) poor. The results suggest there exist unintended negative spillover effects of the federal program on the non-recipient poor, despite benefits for the recipient poor. The previous chapter illustrates that the kind of funding (and associated services) preferred by the non-recipient poor have decreased as a result of *Bolsa Família*. The theory chapter clarified the underlying logic. This chapter illustrates the potential development implications of my argument.

Chapter 6 concludes. Taken together, the findings suggest that the numeric advantage in voting power of the poor in unequal democracies can be offset by constraints on the poor's policy influence from lower vote responsiveness due to diffuse health service demands. Societies in which public service dependence is more equally distributed (regardless of whether it is low or high in absolute terms) should not see the same discrepancies in voting power across voters. The implications, however, are not limited to an income-based application. In this case, income proxies for the breadth and diversity of a group's service demands. The same argument applies to any other proxy (or direct measure) of relative plurality of group demands.

CHAPTER 2

Distribution and the Plurality of Group Demands

When do the poor have the voting power to assert their public service preferences in unequal democracies? Meltzer and Richard famously predict that democratic societies in which a majority of the voting population is made up of the poor will see considerable pro-poor redistribution, especially when the society's income distribution is highly skewed. This follows directly from the median voter theorem—when the voter with the median income is poor and the voter with the mean income is wealthier, the median voter will demand more redistribution. Meltzer and Richard's model is elegant and compelling, but also a poor predictor of redistribution in unequal democracies (Nattrass and Seekings, 2001; Przeworski, 2007; Iversen and Soskice, 2009). Why are Meltzer and Richard's predictions so wrong in politically functional but unequal democracies? Efforts to explain the deviations from the canonical theory often focus on one of two arguments (Harms and Zink, 2003). The first is the argument that under certain circumstances the poor do not prefer redistribution (Benebou and Ok, 2000). The second is that the poor, while perhaps preferring redistribution cannot always hold democratic governments accountable (Stokes, 2005; Nichter, 2008; Taylor-Robinson, 2010; Luna, 2014; Keefer and Khemani, 2003). This paper offers another explanation with implications for political representation in unequal democracies.

The process of preference aggregation via individual vote in democracies leads those with higher levels of dependency on the state for services—typically the poor—to have less voting influence than do those with lower levels of state dependence, if the demands of the more dependent are also more evenly split across multiple services. This is true even when the institutions of electoral accountability function properly. This occurs because the service allocation calculus of tactically-spending, vote-maximizing politicians is sensitive to the vote

responsiveness of an individual or group's vote to strategic spending, and not to absolute demand. As I will demonstrate, when the poor's higher public service demands are divided more symmetrically across competing services and the better-off pile the weight of their votes on fewer services, the votes of the better-off are more responsive to a unit shift in spending, even if their total service demands are lower. This leads to a situation in which spending priorities of (vote-maximizing, tactically-spending) politicians more closely reflect the ordering of the less diffuse preferences of the better-off than of those for whom greater state dependence manifests as multiplicity of service demands. In this chapter I illustrate this logic with a formal decision-theoretic model.

This chapter proceeds as follows. The next section briefly reviews some of the relevant literature on the voting influence of the poor in democracies. I then present the argument as a general model illustrating that a preference for spending on a multiplicity of public services leads a group of voters to be less responsive to shifts in spending between these services. Next I highlight two comparative statics of the model that produce testable implications for future chapters. Finally, I conclude.

2.1 The Leverage of the Poor in Democracies

2.1.1 Voting Influence of the Poor in Democracies

The canonical model of redistribution in the ideal-type democracy is grounded on the observation that, given universal suffrage, the voter with the median income tends to be poorer than the voter with the mean income. Assuming that the poor prefer more income, this implies the poor ought to vote for and benefit from redistributive spending in democracies (Meltzer and Richard, 1981). Even when suffrage is universal, however, the predictive capacity of the Meltzer and Richard model is poor, especially with respect to the effect of a country's inequality (Harms and Zink, 2003).

Other authors have made similar claims about the propensity of democracy to promote pro-poor redistribution due to the mechanism of electoral competition (Lake and Baum,

2001; Besley and Burgess, 2001; Min, 2008). It is relevant to note, however, that much of the empirical work on this topic is based on evidence that democracies spend a lot on public services. This work assumes that these public services are non-excludable and, in particular, that they reach the poor. Given this assumption, the fact that democracies spend a lot of money on services suggests that democracy favors pro-poor access to services. However, empirical research has not demonstrated that such services in fact reach the poor. Other researchers caution that observations of high public service spending in democracies do not necessarily coincide with increased benefits for the poor. Ross finds that while democracies do seem to provide more services, these services do not, on average, improve the overall welfare of the poor. He infers that the benefits of many of these public services may accrue primarily to the middle class (Ross, 2006). Indeed, many public services are inaccessible to certain users based on either *de jure* or *de facto* criteria.

2.1.2 Coalitions and Vote Buying

An alternative approach for analyzing distributional dynamics, which deviates from these ideal-type predictions focuses on a core-swing dichotomy. The "core voter" model suggests that parties acting strategically will spend resources on goods and services for a loyal group of voters, where possible, to maintain a stable majority coalition over time (Cox and McCubbins, 1986). The qualifier, "where possible," is what distinguishes the Brazilian case, which provides the empirical setting for the tests of my argument, from more institutionalized party settings. Brazil has too few core voters to satisfy this criterion.[1] It is common for Brazilians to vote a "split ticket," in which they opt for one party for president and another party for governor (and possibly another party for senator) in the same election. Though the tendency has decreased some since the 1990s, it is not unusual for Brazilian politicians to switch parties (Mainwaring, 1999). The fact that mayors in Brazil are more likely to lose a re-election bid than to win (Titiunik, 2011), implies they often fail to solidify a substantial core during their first terms in office.

[1]There is, however, some recent evidence that partisan identification is relevant for a subset of Brazilian voters (Samuels and Zucco, 2014).

In the absence of a viable core voter distribution strategy, politicians must rely on an alternative spending mechanism. Dixit and Londregan use the term tactical spending to refer to expedient, targeted spending distributed to responsive groups with the aim of gaining votes (Dixit and Londregan, 1996). This differs from the core voter strategy in that the targeted groups may change from election to election. They may also lack any clear ideological affinity with the incumbent to motivate loyalty. Responsiveness to spending and the politician's ability to determine relative response rates are the key determinants of this distribution strategy.

Typically this term is used to describe discretionary spending that entails the threat of discontinuation. For some authors, the ability to monitor voters to make sure they do not renege on a deal to exchange votes for benefits is critical (Stokes, 2005). However, many cases of distribution without a clear objective threat of monitoring have been documented as producing reliable electoral returns for incumbents (Zucco, 2008, 2013; Manacorda, Miguel and Vigorito, 2011; Díaz-Cayeros, Estévez and Magaloni, 2012; de la O, 2013). The mechanism for this is not clear. Some have suggested that "norms of reciprocity" are responsible for high voter response rates to unmonitored spending (Finan and Schechter, 2012). Others focus on whether voters *perceive* themselves to be monitored (Penfold-Becerra, 2007). Still others assume that voters will be responsive to any spending consistent with their preferences, monitoring aside (Persson and Tabellini, 2005; Zucco, 2013). This paper uses this last approach as a simplifying assumption.

2.1.3 Institutional Mediation of Preference Expression

What determines which voters are targeted for policy- and goods-distribution in the absence of stable core coalitions? What governs the way different individuals' demands are prioritized relative to each other in policy-making? A large body of research related to institutional mediators establishes several compelling arguments for sources of variation in voter efficacy. Analyses of these distributional dynamics often focus on the way political institutions mediate preference expression in democracies. This often takes the form of analyzing politician

incentives to respond to different voter demands. For these purposes, voters are often partitioned into the organized (or interest groups) and the unorganized (Denzau and Munger, 1986; Bawn and Thies, 2003),[2] the coordinated and the uncoordinated (Cox, 1997), consumers and producers (Rogowski and Kayser, 2002), or by geographically significant regions (Ames, 1995). Others consider variation across party systems and electoral rules (Carey and Shugart, 1995; Iversen and Soskice, 2006). Empirical work has also suggested that the shape of the distribution of preferences among voters can impact the validity of the median voter theorem's predictions. Gerber and Lewis show, for example, that elected politicians are less constrained by the median in circumstances in which voters are highly heterogeneous (Gerber and Lewis, 2004).

This chapter adds one more explanation to this discussion, pointing to differences in voter responsiveness to spending that I argue are common in unequal democracies and are influential in the context of tactical electoral spending. To address the question of why poor voters often seem to have weak policy influence even when they make up a substantial portion of the voting population, I examine the mechanism of voting in the context of economic inequality, competitive elections and weak political parties. In this context, politicians have incentives to provide the basket of goods that produces the strongest electoral response. Therefore, factors that govern the mapping from individual preferences onto electoral responsiveness are key determinants in the policy leverage of different voters. I define a voter's *policy leverage* (or voting influence) as the degree to which service spending by elected politicians reflects his preferences over competing services.

2.2 The Argument

In my model, a vote-maximizing, tactically-spending incumbent politician makes a spending allocation decision between two competing services. For ease of application to my empirical case, I will refer to the incumbent politician as "the mayor" and the two services competing

[2]See Gilens and Page for a review of the literature on interest groups pertaining specifically to American politics, which is much more extensive than the treatment of interest groups in comparative politics (Gilens and Page, 2014).

for a budget as (municipal) "primary care" and "hospital care" services. If some members of society prefer spending on primary care services and some members prefer hospital care services, the mayor faces a spending tradeoff with respect to these two groups. I argue that the mayor's allocation will be biased in favor of the preferences of the group whose votes are most responsive to a spending shift between these services. I use the model to show that factors other than group size affect this responsiveness. In particular, the group with more asymmetric preferences over the two services has a more responsive expected vote function than the group with more symmetric preferences—even if the total health service demands of the more symmetric group are greater in absolute terms.

These results have implications for the voting influence of the more state-dependent when this group has 1) a different ordering of preferences over services than do the less dependent, and 2) more symmetric preferences than the less dependent. The implications further suggest that when the poor's high dependence (relative to better-off voters) on public services is more symmetrically split across multiple services, they will face a systematic disadvantage in voting influence. This disparity in public service dependence between the poor and the better-off is likely to be most pronounced in unequal democracies.

2.2.1 An Illustrative Model

Suppose individuals, indexed by i, may be classified into two types of voters, with type indexed by $k \in \{P, W\}$. For ease of later empirical applications I will arbitrarily call these voter types "Poor Paulo" and "Wealthy William," respectively. Further suppose the typical voter of type k has a utility function given by

$$U^{\{k\}} = \alpha^{\{k\}} + \beta_P^{\{k\}} x + \beta_H (1 - x),$$

where x is the mayor's allocation to primary care services, $1 - x$ is the mayor's allocation to hospital services, $\alpha^{\{k\}}$ represents utility for type k that is not conditional on the mayor's health allocation, $\beta_P^{\{k\}}$ represents the type-specific responsiveness to the primary care allocation x, and β_H specifies the generic responsiveness of individuals of any type to the hospital

care allocation $1 - x$.

Assuming voters of the same type have the same utility function, which varies only in the individual's belief about the opportunity costs of not voting for the non-incumbent candidate, ϵ may be added to generalize the function across many voters,

$$U_i^{\{k\}} = \alpha^{\{k\}} + \beta_P^{\{k\}} x + \beta_H (1 - x) + \epsilon_i,$$

where $E[\epsilon] = 0$.[3] We can think of ϵ_i as being the individual's assessment of all other vote-relevant factors, including beliefs about the mean quality of the non-incumbent candidate pool, with all individuals' assessments drawn from the same distribution.[4] Then the expected probability an individual votes for the incumbent mayor can be expressed as a function of the type-specific utility function, P(V=1) = $f(U^{\{k\}})$. The functional form of the mapping from utility onto voting propensity is determined by the cumulative distribution of assessments, ϵ_i, across voters (I assume the same distribution of ϵ_i across types). I further assume that $f(U^{\{k\}})$ is a continuous, differentiable function. It follows that the function output falls in the range $[0, 1]$ and that $f'(U^{\{k\}}) \geq 0 \ \forall \ U$. Thus, the expected probability an individual votes for the incumbent mayor is (weakly) increasing in her utility from the health allocation as well as utility derived from other sources.

Assuming that voter assessments are informed by small, independent, additive factors, the Central Limit Theorem implies it is reasonable to model ϵ as normally distributed, as I will do from here forward. Each voter type, then, has a probit function for the probability a group of individuals of that type vote for the incumbent mayor, given by

[3] Here, to compare different utility functions I assume all individual utilities are scaled (normalized) such that β_H is equal in all utility functions and α, β_P and ϵ are defined relative to β_H.

[4] The electoral response to the mayor's service allocation decision depends somewhat on the particular notion of accountability one adopts. This paper uses the notion of accountability offered by Ferejohn, rather than the classical Downsian model. In the Downsian model, voters compare the incumbent's past actions with expectations about the challenger's future performance in making their electoral decision (Downs, 1957). In Ferejohn's work, the voter only derives information from past actions, not promises about the future, and so re-election bids are treated as a referendum on the incumbent alone (Ferejohn, 1986). Besley nicely synthesizes these two models by making the "threshold" against which the incumbent is evaluated the prior mean of the quality of the candidate pool—consistent with the Ferejohnian notion that the election does not provide additional information about the challenger that can be used to update the voter's beliefs (Besley, 2006). The model developed here also treats voting as a referendum on the incumbent.

$$\Phi\left(\alpha^{\{k\}} + \beta_P^{\{k\}} x + \beta_H(1-x)\right),$$

where Φ represents the normal cumulative distribution function.

Suppose "Poor Paulo" depends relatively more on public primary care services than on hospital services, while "Wealthy William" relies on public primary care relatively less than hospitals. The marginal linear response rates of the voter's utility function to the allocation of x are as follows.

$$\beta_P^{\{P\}} > \beta_H > \beta_P^{\{W\}} > 0 \tag{2.1}$$

That is, "Poor Paulo" would rank public primary care as more important than public hospital care (even if he depends on both of these public services to a high degree). "Wealthy William" depends on public hospital care as much as "Poor Paulo" and would rank it as more important than public primary care.[5] The utility function of "Poor Paulo" is, thus, more dependent on state-provided health services than is that of "Wealthy William," since

$$\beta_P^{\{P\}} + \beta_H > \beta_P^{\{W\}} + \beta_H.$$

The function that translates utility into vote propensity maps all response rates onto a comparable 0-to-1 scale.[6] It is this vote responsiveness that matters to an incumbent mayor who is a tactical spender (and not the degree of state dependence of the voter, which is related but not identical). If all voters are of the "Poor Paulo" type, since $\beta_P^{\{P\}} > \beta_H$, an incumbent employing tactical spending would prefer to spend all or most of the funds on primary care. If all voters are of the "Wealthy William" type, since $\beta_H > \beta_P^{\{W\}}$, a tactical-spending incumbent would prefer to allocate the funds principally to hospital care. In reality, we do not have homogenous voters (where all voters can be represented by a single stochastic utility function). Here, I allow groups of voters to be represented by either the "Poor Paulo" or the "Wealthy William" type of voting functions. There is some distribution of the two

[5]Suppose, to give a concrete motivation, "Wealthy William" has access to privately-consumed primary care substitutes while "Poor Paulo" does not.

[6]Response rates can thus be interpreted as marginal rates of substitution.

types of voters in society where w_P is the proportion of the population with utility best estimated by the "Poor Paulo" probit and $1 - w_P$ is the proportion best represented by the "Wealthy William" probit. We can, thus, represent the total expected vote return for the incumbent as the proportion-weighted linear combination of the two probits,

$$E[V|x] \;=\; w_P\Phi\left(\alpha^{\{P\}} + \beta_P^{\{P\}}x + \beta_H(1-x)\right) + (1-w_P)\Phi\left(\alpha^{\{W\}} + \beta_P^{\{W\}}x + \beta_H(1-x)\right).$$

The incumbent's optimal allocation, x^*, given that she prefers to maximize her vote share may be calculated by setting the derivative of the voting function with respect to x equal to zero and solving for x. That is, the incumbent mayor wants to choose x to satisfy

$$\underset{x}{\text{argmax}}\; w_P\Phi\left(\alpha^{\{P\}} + \beta_P^{\{P\}}x + \beta_H(1-x)\right) + (1-w_P)\Phi\left(\alpha^{\{W\}} + \beta_P^{\{W\}}x + \beta_H(1-x)\right).$$

For those interested, the maximization proof of and mathematical solution for the mayor's optimal allocation decision, x^*, are provided in Appendix A.

Comparative Statics

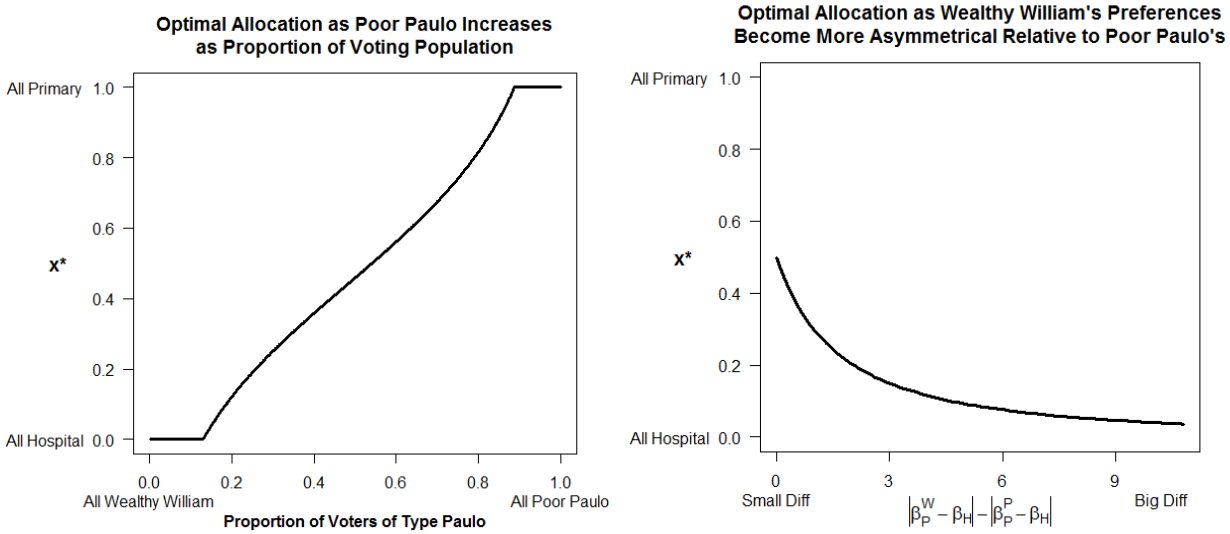
To get a sense for the relative influence of the preferences of voters of each type on the optimal tactical health care allocation for the mayor, I examine how x^* changes when the parameter values change. Below I provide comparative statics to illustrate two theoretical implications of the model regarding *group size* and *relative preference asymmetry*. *Group size* may be understood as movement in w_P. As w_P grows, "Poor Paulo" becomes a larger proportion of the population. I use the term "preference asymmetry" to refer to how much larger or smaller one group's valuation of public primary care is than the same group's valuation of public hospital care. For example, as $|\beta_P^{\{P\}} - \beta_H|$ grows, the preferences of "Poor Paulo" become more asymmetric. *Relative preference asymmetry* refers to the difference in preference asymmetry between groups. So, the preferences of "Wealthy William" become relatively more asymmetric with respect to the preferences of "Poor Paulo" as $|\beta_P^{\{W\}} - \beta_H| - |\beta_P^{\{P\}} - \beta_H|$ grows. So *relative preference asymmetry* is a difference-in-differences measure of

the health service valuations of the two groups.

1. *Group Size.* Intuitively, there exists a positive monotonic relationship between the influence of a voter type on the optimal allocation and the proportion of the voting population that is of that type (see the first plot in Figure 2.1 below).[7]

2. *Relative Preference Asymmetry.* As W's preferences become more asymmetrical relative to P's, W also becomes a more responsive voter relative to P. The incumbent mayor's optimal allocation thus becomes more sensitive to type W's preference ranking relative to type P's. This implication corresponds to the conventional wisdom about the weight of single-issue voters in elections.

Figure 2.1: The Influence of Group Size and Relative Preference Asymmetry



Both plots hold $\alpha^{\{P\}} = 4 - \beta_P^{\{P\}}$ and $\alpha^{\{W\}} = 4$. This normalizes the vote response rate of types P and W to be the same when the type gets its most preferred allocation. The first plot holds $\beta_P^{\{P\}} = 1.05$, $\beta_P^{\{W\}} = 0.18$ and $\beta_H = 1$ constant while w_P changes. The second plot holds $w_P = 0.5$, $\beta_P^{\{P\}} = 1.1$ and $\beta_H = 1$ constant while $\beta_P^{\{W\}} = 0.9 - asymmetry$ moves (increasing in asymmetry).

The first implication is also the central logic of (a stochastic interpretation of) Meltzer and Richard's canonical model. In the stochastic version, a group's policy leverage is proportional

[7]The specific shape of the weakly increasing function is an artifact of the choice to model individuals' beliefs about the quality of non-incumbents as being normally distributed across voters; a different cumulative distribution function would produce different subtleties in prediction, but support the same directional implications.

to group size (rather than policy being determined by a dictatorship of the median voter). In my model, therefore, "Poor Paulo," who would like the allocation $x = 1$, gets $x^* = 0.36$ when 40% of voters share his preferences (for the parameter values set in Figure 2.1). When 60% share his preferences, $x^* = 0.56$. This contrasts with the canonical, deterministic median model, in which, when "Poor Paulo" makes up 40% of the population, $x = 0$, and when "Poor Paulo" makes up 60% of the population, $x = 1$.

The second implication also updates our understanding of Meltzer and Richard. Where the better-off have more asymmetric service preferences than the poor (possibly due to fewer public service demands), the better-off will be more responsive to service spending than the poor. Thus, vote-maximizing incumbent mayors will have the incentive to put more weight on the preferences of the better-off, which is especially important when the poor have a different preference-ordering. Foreshadowing, note that any treatment that alters health service consumption behavior of some subset of the voting population will likely have additional spillover effects on local public service distribution. This will occur whenever the consumption shift alters group vote responsiveness to local service spending by changing group size or the relative preference asymmetry between groups.

2.3 Conclusion

The theoretical model presented in this chapter suggests that tactically-spending, vote-maximizing politicians will put more weight on the preference-ordering of voters who have more asymmetric preferences over competing public services in their spending alloction decisions. The research presented in this chapter can contribute to an updated understanding of Meltzer and Richard's claim that unequal democracies should redistribute more than equal democracies (Meltzer and Richard, 1981). My model suggests that the central intuition behind Meltzer and Richard's argument (or at least a stochastic interpretation of it) is sound—larger groups should have a larger influence on policy, all else equal. However, an additional implication that results from my model is that all other things are often not equal. Another relevant factor is that the preferences of a group that strongly favors one service

to another will receive greater policy weight from vote-maximizing politicians than groups with more symmetrical preferences, even when the service demands of the latter group are larger. In the next chapter, I use survey data to establish which Brazilian voters are type P and which are type W. I return to an assessment of the predictive capacity of my model with respect to spending in Chapter 4.

CHAPTER 3

Brazilian Voters' Health Service Spending Preferences

Opinion studies show access to health services is an electoral priority for Brazilian voters and that these voters are disillusioned with democracy's performance in this regard (The Economist, 2011). For democracy to distribute resources and policies consistent with the demands of the majority, voters must elect candidates that will represent their interests. But if voters care about, say, public primary care services, does it necessarily follow that they will vote for candidates that favor primary care spending? As intuitive as an affirmative response seems, there are several reasons to further investigate the question.

First, the argument presented in Chapter 2 implies the answer is "not necessarily—it depends on what else they need." Second, empirical research suggests that voters, in fact, often fail to vote in favor of policies the voter purports to support (Campbell et al., 1960). Some argue the tendency to express one demand verbally while failing to follow through in terms of voting behavior is due to voters neglecting to act in their own best interests (due to limited information, bounded rationality, or coordination problems). In Chapter 2, I show how a voter with multiple service demands may vote their expressed preferences and still be relatively non-responsive to service spending they demand compared to a voter who only demands one service. This argument helps to explain why voters with many different service demands, who vote their interests every bit as much as voters with more concentrated demands, may have poor response rates to changes in health care spending, even if they care very much about health services and are voting their interests rationally.

In this chapter, I apply the logic of the model presented in Chapter 2 to the specific case of mayoral budget allocation to municipal health services in Brazil. I use original survey data I collected in 38 Brazilian municipalities to empirically identify the health service spending

preferences and voting responsiveness of two groups: the poor and the better-off. I show that the poor and the better-off have similarly high demand for public hospital services, but that the poor have even higher demands for public primary care, while the better-off have lower public primary care demands due to consumption of private substitutes. That is, the poor have more dispersed health service demands than the better-off (the poor have high demand for two kinds of health services; the better-off have demands concentrated on one service). The model in Chapter 2 implies, then, that the poor will be less responsive to shifts in public spending between hospital and primary care services. I use the survey data to show this is indeed the case.

Since poor voters and better-off voters have different interests by definition, their behavior is hard to compare. Therefore, in a second application, I show what happens when a subset of poor voters undergo a treatment (*Bolsa Família* assignment) that downwardly shocks their public primary care dependence. Assignment of a poor voter to *Bolsa Família* treatment decreases the poor voter's dependence on public primary care—thus, assignment serves to concentrate the health demands of the treated on public hospital care. The model presented in Chapter 2 suggests that the treated poor will be more responsive to shifts in health spending than the untreated poor. The logical result, if candidates are tactical spenders, is that the health policy demands of the better-off and the treated poor will be better represented in public spending decisions than the demands of the untreated poor. This implies the *Bolsa Família* Program may decrease the policy influence of the untreated poor group.

This chapter proceeds as follows. First, I provide some stylized details regarding the Brazilian public health system that are relevant to understanding and justifying the application of my model. The following section elaborates on the research design including the logic of the *Bolsa Família* treatment. The next section develops the empirical model and describes the data-collection procedure. I then provide survey results on self-reported service demand and contrast these with results on vote responsiveness to health care spending for the different groups. Finally, I conclude by discussing, based on the results, what incumbent mayoral spending behavior would be expected before an election year with respect to

public primary and hospital care allocations. I return to testing the macro-level spending predictions that derive from these microfoundations in the following chapter.

3.1 Decentralized Public Health Services in Brazil

My application of the theoretical model to the empirical case requires some background knowledge on the decentralized Brazilian public health system. I use municipal-level public health service allocations in Brazil to empirically evaluate vote responsiveness to service spending. This section outlines some relevant stylized details about the national health care system in Brazil. Since mayors allocate health care spending on the ground, the structure of the decentralized health care system plays a critical role in constraining the strategic options available to the mayor in allocating the health funds at her disposal. The relevant points are summarized below.

1. The mayor exerts only marginal control over the size of the municipality's total health care budget.[1]

2. The mayor has a high level of control over the allocation between different health services within her municipality. Given the total health budget, she chooses how to divide the health funds between primary care and hospital services.

3. Within the health sector, the poor and the better-off vary in their demands for primary care services relative to high complexity hospital services. The poor tend to have dependency on the state for both services, whereas the better-off often buy primary care services in the private sector and favor high public spending on hospital services.

The legal groundwork for decentralizing the health care system in Brazil was established in the 1988 Constitution. However, the process referred to as the "municipalization" of health services (the transfer of the principal responsibility for health care implementation to the local level) occurred gradually over the decade of the 1990s (Guanais de Aguiar,

[1]The mayor is subject to a spending floor, but may increase spending beyond this floor. Therefore, in the empirical section I still include statistical control for the size of the total health care budget.

2006). Due to previous underfunding, a constitutional amendment was passed in 2000 which set minimum standards for federal, state and municipal government contributions to the municipality's total health budget. The federal government provides resources on a largely per capita basis. States are required to contribute at least 12% of their revenues to the health budget and municipalities, 15% (World Health Organization, 2010). The mayor is in charge of establishing the annual budget priorities; the agenda then goes to the city council for approval. At this stage it can be amended. The mayor must approve the final version (Müzell de Oliveira, 2009). Despite the mayor's strong influence over allocation priorities, the fact that the minimum contribution standards for each level of government are laid out in the Constitution means the mayor has little control over the size of the total health budget—the caveat being that she may *increase* the proportion of municipal revenues allocated to total health spending. She may not, of course, alter the size of intergovernmental transfers from the state or federal governments or drop below the floor for municipal spending.

Given the health care resources at her disposal and her role in setting budgetary priorities, the mayor's primary strategic choice is a matter of allocation between different health services. There are two discrete health service constituencies in Brazil. For this reason, the system is often described as being "two-tiered" (World Health Organization, 2010).[2] One group is made up of the better-off—primarily people with formal public or private sector employment. This group tends to have access to superior state-subsidized health services, including highly specialized treatment and advanced medical technology.[3] About 23% of the most affluent Brazilians are covered by a private health care plan (The Economist, 2011; Affat, 2012; Gordon, Xu and Xie, 2012). Not all of the "old" middle-class (often unionized,

[2]This class-identified partition in use of health services is rooted in Brazilian bureaucratic history and reflects its pre-2000s class structure (Haines, 1993). A law that first guaranteed public health resources to the formally, privately employed was introduced in 1923. Very limited services were later added for those not in the formal, private sector. This two-tier system remained official until the passage of the 1988 Constitution. Among the constitutional reforms came the guarantee of universal health care access. The aim was to merge the structures by creating a single Ministry of Health and renaming the two systems under the joint rubric, the National "Unified Health System," or *SUS*. Somewhat ironically named, the legacy of the historic two-system division continues to unofficially permeate the Unified Health System. The two are now organized under different branches of the *SUS* (Elias and Cohn, 2003; The Economist, 2011).

[3]This occurs because cutting-edge medical technology is often available at hospitals in affluent areas that are public-private partnerships. It is common in these cases for the private administrators of hospitals to serve privately-insured clients using public resources. It is also common for those who can afford to initially pay out-of-pocket for high complexity services to later request public reimbursement.

formally employed workers as well as public servants) have a private health plan. However, out-of-pocket expenditures on individual private services are a common substitute for insurance for this group (Domínguez Ugá and Soares Santos, 2007). With or without private health care plans, the better-off often consume many primary health care services in the private sector, but rely on the public hospital system for expensive high complexity hospital services.

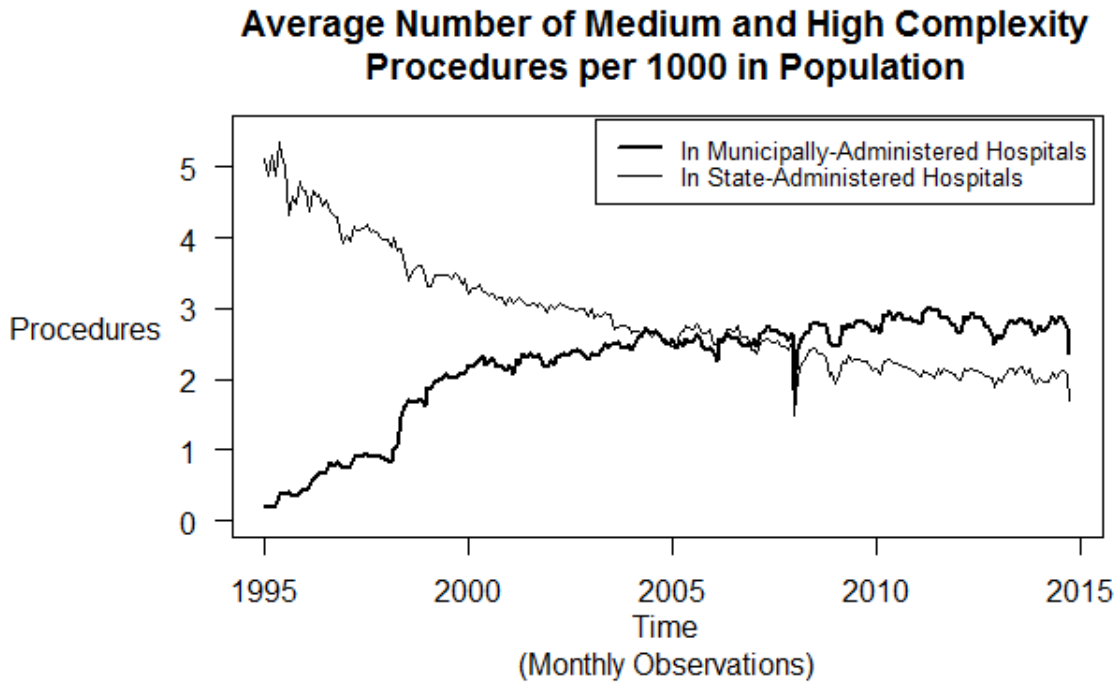
The other group includes poorer voters—often informal laborers (estimated at 43.8% of the population (Paim et al., 2011)) or agricultural workers—who lack a private health insurance plan, the funds to pay out-of-pocket, or the time and resources to advocate for state reimbursement for private care received (Haines, 1993; Hudson, 1997; Elias and Cohn, 2003; The Economist, 2011; Affat, 2012; Gordon, Xu and Xie, 2012; Gerschman, 2013). The latter group, which depends heavily on public clinics for primary health care, tends to deal with long waits, absent doctors and the possibility that their clinic will lack resources as basic as prescription pads (World Health Organization, 2010).

Provision of public primary care services is exclusively the responsibility of municipal governments. Expenditures on primary care go toward financing local clinics, which provide vaccines, check-ups, first-stop treatment for illness, and serve as a gateway into the public health care system for those who lack private insurance. Primary health care expenditures also fund the public provision of basic medications (*Farmácia Popular*) as well as the Family Health Program (*Programa Saúde da Família*), initiated under President Cardoso in the 1990s with an explicitly pro-poor mission—to send doctors and nurses into poor communities that otherwise lack access to primary health services to provide holistic preventative care (Gerschman, 2013).

The funding and administration of public hospitals (and publicly-contracted private hospitals) is split between municipalities and states. As the health care system has become more decentralized, the municipalities have increasingly taken over a larger share of the burden of hospital provision. In many cases, smaller municipalities lack their own hospitals but have pacts with neighboring municipalities to share expenses for a regional hospital, typically located in a larger municipality, that serves all municipalities included in the pact.

Figure 3.1 below shows the evolution of the provision of hospital services (also referred to in the Brazilian system as "medium and high complexity" health services) over time by level of public administration. It tracks the monthly population-weighted municipal average number of medium and high complexity services per 1,000 people in the population provided in state-administered hospitals compared to municipally-administered hospitals. It shows that municipalities have become responsible for the majority of these types of procedures over time (while they continue to be solely responsible for public primary care services).

Figure 3.1: Increasing Municipal Role in Hospital Service Provision



Mayors, thus, increasingly face a tradeoff with respect to the allocation of health funds to primary care and hospital services—which together account for 86% of municipal health care expenditures for the municipalities in my survey sample.[4] In fact, the sampled municipalities had a correlation coefficient of -0.94 between changes in primary care expenditures and changes in hospital care expenditures from 2011 to 2012 (i.e., the year leading up to the 2012 mayoral elections). The correlation coefficient for these municipalities between the total level of per capita spending on primary care and hospital care was -0.99. This provides

[4]The probability sampling procedure that I used in my survey is described in detail in Appendix D.

support for the premise that health service allocations primarily go to either one type of service or the other. Development scholars and professionals have also noted the tradeoff. For example, World Bank experts have observed that "too much of the [health care] budget still goes to hospitals, rather than the Family Health Programme" (The Economist, 2011). An article from the National Institutes of Health comments that the Brazilian system's "limited financial resources have been overconcentrated on health care in the hospital sector...If primary care in Brazil can be improved it could help to narrow the health divide between rich and poor" (Haines, 1993).

This tradeoff is important to voters. The prior evidence suggests that voters care a lot about health services, so making a careful allocation decision is worth the mayor's effort. *The Economist* reports that since 2007, health care has surpassed the economy as the most important issue to Brazilian voters (The Economist, 2011). Furthermore, middle class consumers report that obtaining private health insurance is their number one goal after buying a home (Affat, 2012).

The class-identified health service dichotomy is not unique to Brazil. In fact, Brazil is one of the only countries in Latin America that does not still officially divide health care into a two-part system (The Economist, 2011). Two-tiered systems have also been recently adopted in other developing and middle income countries (McPake, Hanson and Adam, 2007). One pessimistic analysis indicates a strong likelihood that primary health care will end up subsidizing high quality services for the wealthy, rather than the other way around (McPake et al., 2004). While the present research focuses on the Brazilian case, this type of analysis may be generalizable to many other unequal democracies with similarly tiered health systems.

Brazilians spanning the entire range of the income distribution tend to rely on public hospital services for high complexity care, regardless of whether they also possess private health insurance. Therefore, I assume both types of voters (the poor and the better-off), face the same tradeoff with respect to the mayor's hospital care allocation and other electoral incentives (in the language of the model, both groups face the same tradeoff between $1-x$ and ϵ). Thus, allocations to hospital care have the same marginal impact on the utility functions

of both types of voters. However, the poor depend relatively more on public primary care services than on hospital services, while the better-off rely on public primary care relatively less than hospitals (we can imagine the better-off either possess private health insurance or have the financial resources to supplement their public consumption of primary care with privately-consumed primary care).

3.2 *Bolsa Família* and Public Primary Care Dependence

My empirical evaluation focuses first on comparing vote responsiveness to municipal health service spending for the poor (who have more than one health service demand) and the better-off (whose health care demands are concentrated on one service). However, there are many reasons why the vote responsiveness of the poor might be different than the responsiveness of the better-off with respect to health care spending besides the difference in the plurality of the groups' service demands. For example, in order to compare the two groups' responsiveness to spending, one has to believe the assumption that the groups face the same tradeoff between health services and other electoral factors, as outlined above.

Therefore, to test my argument about relative state-dependence on different services in a more conservative context, it would be ideal to (probabilistically) subject the group with more dispersed health service preferences to a treatment that produces a downward shock in treated members' public primary care consumption (thus serving to concentrate group interests on hospital care). This would allow for a controlled test of the claims made in the previous chapter regarding group size and relative preference asymmetry, holding the needs of untreated members of the group constant for comparison.

I proxy for this shift in poor voters' state dependence on public primary care services using the assignment of poor voters to the Brazilian federal government's *Bolsa Família* (Family Stipend) Program (hereafter, the BFP). The BFP is a formulaic, non-discretionary conditional cash transfer program for poor families that makes direct federal transfers to female heads of household when they send their children to school and to preventative doctor's visits. Evidence suggests that the program improves the baseline health of recipients.

As a group, recipients experience health benefits from improved access to nutrition (Medici, 2011) and nearly a quarter of recipient families report spending part of their transfer funds on privately procuring medications each month (Ministério de Desenvolvimento Social, 2008). These are services that would otherwise typically be provided locally through public primary care. As a result, *Bolsa Família* decreases the dependence of recipients on local government-provided primary care services, while leaving the needs of the non-recipient poor unaltered.[5]

The BFP treatment is imperfectly assigned across poor voters in Brazil owing largely to the infrequency with which income records are updated for this population, which is characterized by highly volatile income (Soares, Ribas and Osório, 2010), creating an observable source of variation in dependence on public health services among the poor. For a detailed analysis of the probability of assignment by income and the plausibility of the untreated (non-recipient) poor as a counterfactual for the treated (recipient) poor, see Appendix B.

After comparing the vote responsiveness of poor voters (specifically, those who have not received BFP assignment) with the voting behavior of the better-off, I turn to examining the results of the shock the BFP applies to the needs of a subset of poor voters with respect to public primary care services. The model suggests this shock should affect the relative policy weights politicians assign to the recipient (treated) and non-recipient (untreated) poor. I use original survey data to show that the decreasing dependence of program recipients on public primary care services induces 1) a shift in preference ordering of primary care and hospital care among the treated poor (i.e., a decrease in *group size* for the group that prefers primary care) and 2) shifting preferences that are increasingly concentrated on only one of the two health services for the treated poor (i.e., an increase in *relative preference asymmetry* between the treated poor and the untreated poor).

My data focus on one state in Brazil, Minas Gerais, in order to hold the institutions of electoral accountability constant. I examine the vote responsiveness of these groups of voters to changes in municipal budget allocation to primary care during the 2012 municipal elections in Brazil to generate predictions about changes in mayoral health service allocations. I revisit

[5]Though the program is conditioned on periodic use of primary care, it changes recipients' usage of primary care to more preventative rather than curative and palliative treatment, which improves baseline health, as do the cash transfers themselves, both decreasing state dependence for basic care.

these predictions in the next chapter.

3.3 The Empirical Model

For the purpose of this model, voters always vote their preferences; they are not strategic. I divide the voters into three sub-types for the empirical model. I subdivide the poor into the treated (program recipient) poor and the untreated (non-recipient) poor, and I compare the untreated poor with the treated poor as well as with the better-off. The responsiveness of these three groups informs the mayor's allocation decision with respect to primary care expenditures, given the total health budget. The groups are as follows:

1. the "non-recipient poor" (or untreated poor) are voters who I classify as poor based on their income, but who have not been assigned recipient status in the BFP. These voters provide a baseline for estimating the voting behavior of the poor in the absence of the BFP.[6] They are hypothesized to behave most like "Poor Paulo" from the illustrative model, with high total health care needs, and an ordinal preference ranking favoring primary care services.

2. the "better-off" are voters who I do not classify as poor. These voters provide an alternative baseline for vote responsiveness to primary care spending. They are hypothesized to behave most like "Wealthy William" from the illustrative model, responding to hospital services as much as poor voters, and preferring hospital services to primary care, thus having lower total state dependence than the non-recipient poor.

3. the "recipient poor" (or treated poor) are voters who I classify as poor based on their pre-transfer income, and who have experienced the "shock" to their health care needs from program-enrollment and receipt of a monthly stipend.[7] Recipient status

[6]See Appendix B for an analysis of the validity of the claim that the non-recipient poor provide a counterfactual for the recipient poor.

[7]Though very few voters (just over 5%) classified as "better-off" in the sample (those in households that earn more than one-half the monthly minimum wage per capita) receive transfers from the BFP, I do not address the impact of recipient status for the "recipient better-off." This group is hypothesized to behave most like "Wealthy William" even before receiving the transfers and so recipient status should not induce

is hypothesized to decrease this group's public primary care needs. With respect to the illustrative model, this group represents a transition from health care preferences consistent with "Poor Paulo" to those consistent with "Wealthy William."

Thus, there are three relevant voter types including two static-preference groups (the non-recipient poor and the better-off) and one dynamic-preference (treatment) group (the recipient poor). Let $k \in \{pR,\ p\bar{R},\ w\}$ indicate the income group identifier and transfer status of voter i in municipality j for poor recipients, poor non-recipients, and the better-off, respectively. Each individual has a voter response function. Let $\gamma^{\{k\}}$ denote the dependence on public primary care of individuals in group k *conditional* on total health care spending. Thus, $\gamma^{\{k\}}$ in the empirical model is the equivalent of $\beta_P^{\{k\}} - \beta_H$ in the illustrative model. It is not constrained to be positive (in fact, directionality indicates voter type). In the empirical section, I use the response to the *change* in allocation rather than the allocation *level* because there is only moderate change from year-to-year and because the change is less likely to be correlated with unobserved municipal variables. I also control for the level of expenditure in the previous year to isolate the reaction to the recent change. Let δ_j denote the change in the level of the fixed health budget from 2011 to 2012 and let x_j denote the proportion of that budgetary change allocated to primary care in municipality j in 2012 (the election year).

Holding the total health budget constant, any shift in spending favoring primary care is inherently a shift away from funding hospital care and vice versa. This leads to an important modeling decision—the illustrative model cannot be fully identified in empirical estimation. Once controlling for the total health budget size, linear responsiveness to primary care and hospital care cannot be simultaneously identified due to multicollinearity. I instead include the measure of changes in allocation to primary care and a measure of change in total health budget size, omitting the hospital spending variable under the assumption that the need for public hospital care will be captured by the coefficient on change in total health budget size (conditional on primary care expenditures), ψ. In the model I allow γ, the conditional

an observable switch. Therefore, I include these cases within the group classified as "better-off," providing "Wealthy William" baseline.

responsiveness to public primary health care, to vary across voter type, k. Consistent with the illustrative model, however, I assume all voter types have similar levels of state dependence on public hospitals. Thus, ψ is the empirical measurement of the parameter β_H in the illustrative model.

This paper treats health spending as being rivalrous (multiple individuals cannot consume the same service at the same time, which is descriptively accurate for most medical services).[8] It then makes sense to measure the level and change in primary care allocation and the size of the total health budget in some sort of per capita terms. Since, as detailed in the background section of this chapter, public primary care services are more heavily used by the poor whereas need for public hospital services is more universal, I measure the level and change in allocation to primary care services per poor head, as a practical representation of its usage. I measure the level and change in the total health care budget in per capita terms. Let n_j denote the size of the poor population in municipality j and N_j denote the size of the whole population in that municipality. Then $\gamma^{\{k\}}$ measures the linear responsiveness of individuals in each group, k, to a unit increase in $\frac{x\delta_j}{n_j^p}$, or a one-*real* (the Brazilian currency) increase in primary care spending per poor head *conditional* on the change in the total health budget *per capita* $\frac{\delta_j}{N_j}$.

Various demographic and political vote predictors are represented by the vector of random variables, Z_i. The constant, $\alpha_j^{\{k\}}$ represents any general (dis)advantage of incumbency with respect to the group, k (the equivalent of $\alpha^{\{k\}}$ in the illustrative model). I model this incumbency (dis)advantage as a random effect, varying across municipalities. An individual voter, i, in municipality j has a systematic component to their vote choice (a linear combination of $\frac{x\delta_j}{n_j^p}$, $\frac{\delta_j}{N_j}$ and Z_i), and an idiosyncratic one, ϵ_i, observed by neither the mayor nor the researcher. I model the individual voter response function as follows, where individual i

[8] Take, for example, a paper prescription, an hour with the doctor, a vaccine, etc.

belongs to group k.

$$\alpha_j^{\{k\}} + \gamma^{\{k\}} \frac{x\delta_j}{n_j^p} + \psi \frac{\delta_j}{N_j} + \lambda Z_i + \epsilon_i \tag{3.1}$$
$$\epsilon_i \sim \ N(0, \sigma^2)$$

Individual i votes for the incumbent mayor if Equation 3.1 evaluates to some number greater than 0 and, otherwise, votes against the incumbent.

$$\begin{aligned} Pr(y_{ij} = 1) &= Pr(\alpha_j^{\{k\}} + \gamma^{\{k\}} \frac{x\delta_j}{n_j^p} + \psi \frac{\delta_j}{N_j} + \lambda Z_i + \epsilon_i > 0) \\ &= \Phi(\alpha_j^{\{k\}} + \gamma^{\{k\}} \frac{x\delta_j}{n_j^p} + \psi \frac{\delta_j}{N_j} + \lambda Z_i) \end{aligned} \tag{3.2}$$

In Equation 3.2, Φ represents the standard normal cumulative distribution function.

The mayor of municipality j chooses an allocation shift to primary care, x. The mayor ought to choose x (given the total health resources available *per capita*, $\frac{\delta_j}{N_j}$, and given the proportion of voters in the municipality that are poor, $\frac{n_j}{N_j}$) to maximize her expected vote share. The underlying propensity to vote for the mayor, α, will be informed at least in part by the remainder of the mayor's distribution strategy (which is not modeled strategically here, but which will be captured by the intercept term, the general underlying propensity to vote for the mayor).

I estimate $\alpha_j^{\{k\}}$, $\gamma^{\{k\}}$, ψ, and λ using original survey data collected during Brazil's 2012 municipal elections. The number of within-municipality observations is too small for independent analyses for each municipality. Instead, I employ a partial-pooling (shrinkage) estimator, allowing municipalities to "borrow" strength from out-of-municipality observa-

tions informing the grand (pooled) mean. Equation 3.2 gives us the following model.

$$
\begin{aligned}
y_{ij} &\sim \ Bernoulli(\pi_{ij}) \\
\pi_{ij} &= Pr(\alpha_j^{\{k\}} + \gamma^{\{k\}} \frac{x\delta_j}{n_j^p} + \psi \frac{\delta_j}{N_j} + \lambda Z_i + \epsilon_i > 0) \\
\epsilon_i &\sim \ N(0, \sigma^2)
\end{aligned}
\tag{3.3}
$$

The voter types, k, enter the model as interaction terms for the intercept, α_j, and the coefficient on primary care spending, γ. The vector of parameters, λ, may be interpreted as the relationship between several municipal, political and demographic characteristics and the linear propensity for individual i to vote for the incumbent mayor. The municipal variables attempt to address factors outside of the mayor's allocation decision that year which may alter the impact of a given shift toward or away from primary care spending. These include a measure of the per capita level of municipal budget expenditures on health and per poor spending level on primary care in the previous budgetary year. They also include the change in the size of the total health budget per capita for this budgetary year (which, since conditioned on primary care expenditures, captures responses to changes in hospital spending). Additional municipal-level factors include the size of the municipal population and the percentage of that population I classify as "poor."[9]

The estimated voter response function also accounts for the influence of various individual-level political and demographic characteristics. Though relatively few survey respondents reported "preferring one political party to the others," for those that did report a party preference, preferring the mayor's party is a strong predictor of voting for the incumbent. In addition to an indicator for whether the respondent reported preferring the mayor's party, individual level predictors include age, sex, and per capita household income.

[9]The cutoff I use to classify voters as "poor" is per capita household income of less than one-half the federal minimum wage in 2012 (in Brazilian currency, 622 *reais*).

3.3.1 Empirical Identification of Preference Type

The hypotheses regarding preference ranking elaborated in Table 3.1 are based on a qualitative understanding of the health care system, described in the background section of this chapter. Empirical identification of preference types is necessary in the application of the model to the specific case. The hypotheses identify the three groups of voters (non-recipient poor, recipient poor and the better-off) as either the type that prefers public primary care spending to hospital spending or the type that prefers hospital to primary care spending. The hypotheses in Table 3.2 formalize predictions about relative preference asymmetry between the three groups based on the notion that the untreated poor have more diffuse health service preferences than either the treated poor or the better-off.

3.3.2 Data

The data I use to classify voters into the three groups and estimate the voter response function of each comes from three sources.[10] The individual covariates and the observations on vote choice come from an original survey implemented within the two weeks prior to the 2012 municipal elections in Brazil. Brazilian enumerators administered the survey face-to-face to a probability sample of 1,200 individuals from across 38 municipalities in the state of Minas Gerais. The sampling frame includes individuals of voting age (≥ 16) in municipalities where the incumbent ran for re-election in 2012. The survey elicited mayoral vote choice without priming respondents on health expenditures. The goal was not to gauge cognition of expenditure decisions, but simply to observe the probability of re-electing the incumbent, given the incumbent's observed health expenditure behavior in the last year. The data on municipal finance come from the records of the National Treasury of Brazil. Population

[10]The cutoff I use to classify voters as "poor" is per capita household income of less than one-half the federal minimum wage in 2012 (in Brazilian currency, 622 *reais*). Approximately 40% of my sampling frame falls in this category according to the 2010 Census microdata. If the parameter values of the first plot in Figure 2 reflect reality, we would expect about 36% of the municipal budget to be spent on primary health care when about 40% of the population is classified as "poor." Compare this to the sample, where the median individual lived in a municipality that spent 22.2% of the health care budget on health in 2012, the mean voter lived in a municipality that spent 40.9%, and the mean (not population-weighted) municipality in the sample spent 58%.

Table 3.1: Linear Responsiveness Hypotheses

	Model Implication	Empirical Prediction	Explanation
H_1:	$\beta_H > 0$	$\psi > 0$	The model assumes that responsiveness to hospital care spending should be positive, suggesting voters of all types prefer more hospital spending to less hospital spending. In the empirical model, this will be measured by the coefficient (which I denote ψ) on the change in total health spending per capita. Since the model also conditions on the change in primary care spending, ψ effectively measures responsiveness to hospital care spending since total health spending is almost perfectly correlated with the sum over primary and hospital care spending.
H_2:	$\beta_P^{\{P\}} > \beta_H$	$\gamma^{\{p\overline{R}\}} > 0$	I hypothesize that poor non-recipient voters are type "Poor Paulo"—that is, they prefer primary care spending to hospital spending. In the empirical model, this will be interpreted as the prediction that $\gamma^{\{p\overline{R}\}} + \psi > \psi$, which simplifies to $\gamma^{\{p\overline{R}\}} > 0$. That is, responsiveness of the non-recipient poor to primary care spending is positive after conditioning on changes in the sum over primary and hospital (total health) spending that year.
H_3:	$\beta_P^{\{W\}} < \beta_H$	$\gamma^{\{pR\}}, \gamma^{\{w\}} < 0$	I hypothesize that the recipient poor and the better-off are type "Wealthy William"—that is, they prefer hospital spending to primary care spending. In the empirical model, this will be interpreted as the prediction that $\gamma^{\{pR\}}, \gamma^{\{w\}} + \psi < \psi$. This simplifies to $\gamma^{\{pR\}}, \gamma^{\{w\}} < 0$. That is, responsiveness of the recipient poor and of the better-off to primary care spending is negative after conditioning on the change in the sum over primary and hospital (total health) spending that year.

Table 3.2: Relative Preference Asymmetry Predictions

	Empirical Prediction	Explanation
H_4:	$\left\|\gamma^{\{p\overline{R}\}}\right\| < \left\|\gamma^{\{w\}}\right\|, \left\|\gamma^{\{pR\}}\right\|$	If H_1 is correct, then voters respond positively to total health spending. Then the smaller the absolute response to changes in primary care spending, conditional on changes in total health spending, the more symmetrical the voter's response to the two health goods, public primary and hospital care. I use this measure to test the relative symmetry of the untreated (non-recipient) poor and the better off and the relative symmetry of the untreated (non-recipient) poor and the treated (recipient) poor. My *a priori* belief is that the better-off and the treated poor will have more concentrated (less symmetrical) preferences due to lower primary care dependence.

data comes from the *Instituto Brasileiro de Geografia e Estatística*, which implements the Brazilian Census. I detail these data sources in Appendices D (survey design and other data details), E (justification of the selection of the state of Minas Gerais for the sampling frame), F (survey design summary), G (representativeness of the sample) and H (quality of vote prediction estimates).

While most of the survey questions produced response rates with very little missingness, there was considerable missingness on the vote choice responses (about 50%). This is common in vote choice surveys. Assuming this missingness is not correlated with other important covariates across cases, the analysis benefits from data imputation via an Expectation-Maximization (EM) algorithm. This is an iterative process where the non-missing data are used to fit the model parameters, the model parameters are used to predict missing values of the dependent variable, and the new complete dataset is used to generate new parameter estimates, again. The process cycles until the predicted values for the missing data are identical in two successive iterations. For the hierarchical analysis presented in the results

section of this chapter, the results are for the EM-imputed data. To view the results that are produced without imputing the missing values, see Appendix K. The EM algorithm roughly doubles the sample size of the analysis, though the size and direction of the results of the analysis are effectively identical with or without the data imputation procedure.

3.4 Survey Results

This section presents the results of the survey analyses. First, I provide evidence regarding health service usage for the poor and the better-off to corroborate the qualitative intuition in the background section that hospital usage rates are fairly consistent regardless of class, but that the poor rely more on public primary care services than the better-off. I then present the results of the hierarchical model described above.

3.4.1 Service Usage

One question my survey enumerators asked survey respondents was, "*Quando você ou alguém na sua família está doente, aonde você tipicamente vai primeiro?*" This translates to, "When you or someone in your family is sick, where do you typically go first?" Listed options included a public primary care clinic, a private primary care clinic, a public hospital or emergency room, a private hospital, the pharmacy or a drug store, or other (including religious treatment). Table 3.3 reports the percentage of those survey participants I classify as "poor" or "better-off" (according to their per capita household income) that typically go to a public clinic or hospital as their first stop, respectively. These numbers serve to bolster the qualitative assessment that hospital usage varies little between the poor and the better-off, while the poor's public primary care usage far surpasses that of the better-off. It is important to note that these numbers represent first-visit usage, which should not be interpreted directly as service valuations. However, they do reveal that the poor and the wealthy have similar first-time usage rates for hospitals, but that the poor are much more reliant on public primary care than are the better-off for their first-stop visits.

Table 3.3: First Stop Consumption Rates of Public Primary and Hospital Care

Service	Poor	Better-off	Difference (Poor - Better-off)
Public Clinic	61.0%	42.3%	+18.7
Hospital	28.4%	32.2%	- 3.2

3.4.2 Responsiveness to Changes in Health Service Spending

Table 6.2 summarizes the results of the hierarchical analysis. The estimates for the key explanatory variables, γ and ψ, appear under the sub-headings "Responsiveness to Primary Care Spending" and "Responsiveness to Hospital Spending," respectively. The first hypothesis states that $\psi > 0$, i.e., that voters respond positively to changes in total health spending, even after conditioning on primary care spending. The results in Table 2 show that the directionality of this prediction is correct; however, the results fall short of conventional standards of statistical significance, with a p-value of 0.165. Still, in substantive terms the size of the result is non-trivial. Across municipalities in the sample the marginal increase in the incumbent mayor's vote share associated with an increase in one *real* in health care expenditures per capita was 0.12%. The median increase in health spending across the sampled municipalities in 2012 was 40.64 *reais*. This suggests a large increase in vote share for the incumbent associated with increasing the size of the hospital care budget, holding the primary care budget constant.

I then estimate three different responses to changes in primary care spending for the "non-recipient poor," "recipient poor," and the "better-off," respectively. Non-recipients provide a baseline expectation for how poor voters respond electorally to shifts in health spending absent federal transfer receipt, i.e., without a negative shock to their public primary care demands. The second hypothesis predicts that the non-recipient poor will favor primary care to hospital spending in their voting behavior, despite responding positively to both. If the second hypothesis is correct, $\gamma^{\{p\overline{R}\}} > 0$; that is, conditional on total health spending, the non-recipient poor still respond positively to primary care spending. Recall that because the non-recipient poor are very reliant on the state for all health care needs, we expect them to have highly symmetrical (dispersed) preferences over the two public health services.

Hence, the expectation is that they will not be very responsive to shifts in spending priorities between primary and hospital care, even though they favor primary care. The direction of the result is consistent with the hypothesis, while the magnitude of the positive response to primary care for this group is not statistically significantly larger than their response to total health care expenditure. According to the formal results from Chapter 2, the small size of the positive primary care response for the non-recipient poor group is consistent with the qualitative claim that this group has a high degree of symmetry (dispersion) over preferences for primary and hospital care.

The better-off voters provide a different baseline for comparison. The third hypothesis suggests that they should be more responsive to hospital spending than to primary care spending. If this is true then $\gamma^{\{w\}} < 0$; that is, once controlling for total health expenditures, primary care expenditures produce a negative response. The results provide statistically significant support for this hypothesis, suggesting the better-off prefer increases in health funding to go to hospital rather than primary care. In fact, in marginal effects, choosing to spend one *real* (per poor head) of health care funds on primary care rather than hospital services is associated with a loss in 0.09% of the incumbent's vote due to the negative response of the better-off. Compare this with a marginal gain in expected vote share of 0.02% from the non-recipient poor for the same one *real* shift. The estimates suggest $\left|\gamma^{\{w\}}\right| > \left|\gamma^{\{p\overline{R}\}}\right|$, providing support for the fourth hypothesis that the better-off have more asymmetric (concentrated) health service preferences than the non-recipient poor. The model implications, thus, suggest that the preferences of the poor will receive less weight in the vote-maximizing mayor's optimal spending allocation than the preferences of the better-off.

The third hypothesis also suggests that poor recipients will prefer hospital to primary care spending—deviating from their public primary care-demanding counterparts who do not receive the federal transfer. If this hypothesis is correct, $\gamma^{\{pR\}} < 0$. The results provide statistically significant support for this prediction. The effect is quite large suggesting an asymmetry in favor of hospital care for this group almost on the same order as the asymmetry of the better-off. This is surprising since the transfer amount is small (only large enough to move 8.6% of BFP recipients in my sample past the one-half the minimum wage per

capita household income cutoff I use to distinguish the poor from the better-off). It suggests assignment to recipient status could entail a health-preference-shifting mechanism beyond just increased funds-in-pocket, which merits further investigation. The results suggest that the transfers should decrease the weight mayors place on the health preferences of the poor in two ways: by decreasing in their group size and by decreasing their relative voting influence due to increased concentration of transfer recipients' preferences.

3.4.3 Other Predictors of Vote Choice

Though the aim of this chapter is to provide evidence for class-based response rates to changes in municipal health care allocation, the results regarding other predictors of Brazilian vote choice are also interesting. I find a higher *level* of total per capita health spending in the previous year (2011) is weakly negatively associated with the incumbent's voteshare in 2012. This correlation is likely due to the fact that the local executive has a more difficult job with respect to health care provision in municipalities with a higher disease burden, high levels of transit, or high levels of violence. Controlling for this starting level, the *change* in the spending level should not be driven by the geography of disease burden. Interestingly, however, the *level* of primary care per poor head in 2011 is positively and statistically significantly associated with voting for the incumbent.

Generally, the municipal-level variables were moderately predictive of individual vote choice. Individuals sampled from larger municipalities (cities) were more likely to vote for the incumbent, though not significantly so. This result seems especially true for the state capital, Belo Horizonte, which has the largest municipal population in the state, by far. There, the incumbent is significantly more likely to be re-elected than in the typical municipality in the sample. Individuals sampled from municipalities with a larger percentage of the population classified as "poor" were also more likely to vote for the incumbent. Though this result is difficult to interpret directly since it is conditional on controls for the underlying propensity to vote for the incumbent for each of the three income-based groups (the intercept terms), it is consistent with the the claim that poor geographic areas tend to favor incumbents (Zucco,

2008).

Generally, the individual-level demographic variables were highly predictive of vote choice. Preferring the mayor's party to others strongly predicts voting for the incumbent (though relatively few people report having such a preference).[11] The impact of household wealth on voting for the incumbent is complex (and possibly non-monotonic). Being classified as "better-off" is significantly associated with an increased likelihood of voting for the incumbent. However, conditional on this dichotomous income distinction household income per capita, as a continuous variable, is significantly associated with a decreased probability of voting for the incumbent. This suggests that propensity to vote for the incumbent is different among the moderately-better-off and the very wealthy. Being older and being a woman are also both significantly associated with voting for the incumbent.

[11] Just over 12% of those sampled (or about 16.5%, applying inverse-sampling weights) report preferring the mayor's party to other parties).

Table 3.4: Hierarchical Probit Results

Variable	Coef
Underlying Propensity to Favor Incumbent	
$\alpha^{\{p\overline{R}\}}$ (Intercept: Poor Non-Recipient)	-1.341 0.489 (1.938)
$\alpha^{\{pR\}}$ (Intercept Shift: Recipient)	-0.152 0.415 (0.187)
$\alpha^{\{w\}}$ (Intercept Shift: Better-off)	0.788*** 0.000 (0.166)
Responsiveness to Primary Care Spending	
$\gamma^{\{p\overline{R}\}}$ (Poor Non-Recipient)	0.001 0.727 (0.002)
$\gamma^{\{pR\}}$ (Poor Recipient)	-0.003** 0.009 (0.001)
$\gamma^{\{w\}}$ (Better-off)	-0.003*** 0.000 (0.001)
Responsiveness to Hospital Spending	
ψ Change in Total Health Spending/Cap	0.005 0.165 (0.004)
Health Expenditure Context	
λ_1 Total Health Spending/Cap 2011	-0.001 0.287 (0.001)
λ_2 Primary Care Spending/Poor Head 2011	0.001*** 0.000 (0.000)
Municipal Vote Predictors	
λ_3 Municipal Population (Logged)	0.007 0.961 (0.143)
λ_4 Percent of Pop Classified as Poor	0.020* 0.095 (0.012)
λ_5 Dummy for State Capital	1.526** 0.034 (0.720)

Continues

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Variable	Coef
Individual Vote Predictors	
λ_6 Co-Partisan with Mayor	2.080***
	0.000
	(0.244)
λ_7 Household Income/Cap (Logged)	-0.281***
	0.000
	(0.057)
λ_8 Age	0.012***
	0.000
	(0.003)
λ_9 Female	0.348***
	0.001
	(0.106)

Note: Reported values include the estimate, p-value, and standard error. The ***,**, and * notation denotes statistical significance for a two-tailed t-test (0.01, 0.05, and 0.10 α levels, respectively). The model includes 885 observations with complete data after EM imputation. The standard deviation of the random intercept is estimated to be 0.513.

3.5 Discussion and Conclusions

In this chapter, I use evidence from original survey data to estimate revealed preferences through voting behavior. I show that the group one would expect to be the most dependent on public health services is, paradoxically, the least responsive to shifts in spending across these services. Using the survey data, I show that the poor and the better-off in Brazil have competing preferences regarding public health service spending. The poor respond more positively to shifts in spending priorities favoring public primary care and the better-off respond positively to those shifts that favor hospital care. However, the better-off have a stronger response rate to these spending shifts than do the poor. Interpreted using the model from Chapter 2, this suggests that the poor have relatively more symmetric preferences over public primary and hospital care services than the better-off, whose demands are more concentrated on hospital care alone.

I also provide evidence that a downward shock to the public primary care demands of the poor (induced by assignment to the *Bolsa Família* Program) is associated with a reversal

of the preference ordering of the recipient (treated) poor. The shift in preferences away from primary care serves to concentrate the health service demands of this group on hospital services. This weakens the policy influence of the non-recipient (untreated) poor group in two ways. It decreases the proportion of the population that shares their preference ordering (i.e., it decreases their *group size*). By concentrating the interests of the recipient poor on hospital care, the treatment also increases the responsiveness of the recipient poor to spending shifts relative to the non-recipient poor, who do not change. This is due to increased *relative preference asymmetry* for the recipient poor group (compared to the non-recipient poor).

There are several points of irony here worth noting. The first is that the recipient poor have higher absolute demand for health care services, but less influence on how health care service funds are spent. The second is that the non-recipient poor undergo decreased policy influence without having to change their behavior at all. The democratic game is scaled in relative terms. Preference movement from another group changes the influence of all groups on policy. Because it is *relative* preference asymmetry across groups that is important, the non-recipient poor's influence is downgraded simply through increasing the preference asymmetry of a different group (the recipient poor). This leads to the final point of irony: if my model is descriptively accurate, the non-recipient poor act as rationally as all other groups, but are disadvantaged in policy influence precisely due to their higher level of demand for primary care services.

Typically, in rational choice analyses, an equally high degree of demand for spending on two services that share a budget is interpreted as indifference between the two. In these analyses, we do not distinguish between indifference caused by similarly high demand for two competing goods (possibly better termed "ambivalence") and indifference caused by similarly low demand for two competing goods, though one might argue these two are fundamentally different situations. "Indifference," at least colloquially, implies a low cost to a given tradeoff, while "ambivalence" implies a high cost to the tradeoff. This research highlights that, like rational choice analysis, the accountability mechanism in democracy does not distinguish between the low-cost tradeoff and the high-cost tradeoff. It reminds us that perceived indifference can exist concurrently with high demands. This highlights

a problem in the logic which suggests higher demands in democracy should always lead to higher yield from accountable politicians. The results imply that even when the poor weakly prefer more primary care spending and when institutions of democratic accountability are functioning properly, tactically-spending politicians still may have an incentive to put more weight in allocation decisions on the demands of the wealthy when they value fewer services.

I lay the groundwork here to test secondary predictions of the model regarding observed spending allocations in the next chapter. These predictions derive from the same model and its comparative statics from the previous chapter. The analyses also incorporate what we now know about Brazilian voters and health care responsiveness. In particular, this and the previous chapter, taken together, imply that *Bolsa Família* distribution should be associated at the municipal level with shifts in spending priorities toward hospital care and away from primary care, given a fixed budget. I return to testing this claim in the next chapter.

CHAPTER 4

Bolsa Família and Migrating Municipal Health Funds

Despite a constitutional guarantee to public health care, inadequate health services remain one of the most important issues to Brazilian voters. According to Datafolha, a polling firm in Brazil, during the 2014 elections 93% of Brazilians felt inadequate health care was among the most pressing electoral issues in Brazil (Sant'Ana, 2014).[1] An accountability logic suggests provision of these services by local elected officials depends on voter usage of and demand for these services. However, the public provision of services like primary health care in democracies is anything but automatic even if constituents care about their health (Keefer and Khemani, 2005; Khemani, 2007; Ross, 2006; Devarajan and Widlund, 2007; Booysen, 2007; Gupta et al., 2014; McGuire, 2010; Luna, 2014). In Chapters 2 and 3 of this dissertation I elaborate on one possible mechanism that may underlie this phenomenon. The chapters show theoretically and then empirically that "demand" for services does not necessary translate into high "vote responsiveness" to public spending on those services.

In particular, Chapter 3 shows that when poor voters receive a downward shock to their public primary care dependence, their vote responsiveness to health service spending actually increases (favoring hospital care). In this case, decreased demand translates into increased influence for this group on health spending allocation decisions. If this is accurate, then the federal program, *Bolsa Família*, or BFP, that decreases recipients' demand for public primary care spending should be associated at the municipal level with shifts in health care spending away from primary care and toward other services like hospital care. This chapter investigates this prediction.

The chapter proceeds as follows. First, I elaborate on the theoretical context for this

[1] http://portal.cfm.org.br/images/PDF/apresentacaoCFMdatafolha.pdf

investigation by explaining the municipal-level implications of the findings in Chapter 3. I then discuss how these predictions interact with existing theories of public finance. Then I provide details on the empirical strategy I use to evaluate the predictions. The results regarding the relationship between the BFP and municipal spending on public primary care follow. I complement these results with an analysis of whether the movement of funds represents effciency gains in primary care provision or loss of access to primary care services for the non-recipient poor, an exploration of where the migrating health funds seem to be traveling, and a discussion of whether the association between the BFP and the emigrating health funds can be explained by one or both of the comparative statics from the model in Chapter 2. Finally, I conclude by summarizing the implications of the findings.

4.1 Theoretical Context

4.1.1 Municipal Spending Implications of Vote Responsiveness Findings

Chapter 3 suggests that an increase in BFP coverage in a municipal population should be associated with decreased primary care spending at the municipal level. This is because the BFP is associated with a decrease in *group size* for the health constituency that prefers primary care. If this is logic is correct, another implication is that the health service funds should move toward hospital services, since *group size* for this health service constituency has increased (proportional to the size of the municipal population covered by the BFP). Furthermore, since BFP makes recipients more responsive to shifts in spending than the non-recipient poor—thereby increasing the *relative preference asymmetry* of the recipient poor—the effects of BFP should be greater-than-proportional to the coverage of the BFP in a given municipality. In Table 4.1, I summarize these predictions, which derive from the theoretical concerns in Chapter 2, along with the practical application to group voting behavior covered in Chapter 3. The Results section focuses on the primary hypothesis, H_1. I return to examining the other hypotheses in the Discussion section.

Table 4.1: Public Primary care Spending Hypotheses

	Empirical Prediction	Mechanism
H_1:	Public primary care spending decreases at the municipal level in conjunction with the percentage of the population that is assigned to the BFP.	The BFP should be associated with a decrease in the group size of the municipal population that prefers public primary care spending to hospital spending.
H_2:	The decreased spending on primary care services predicted by H_1 should produce decreased access to services; that is, it should not simply result from efficiency gains in primary care provision.	According to my argument, the expected shift in health service funding from primary to hospital care results from a reordering of provision priorities.
H_3:	Public hospital care spending increases at the municipal level in conjunction with the percentage of the population that is assigned to the BFP.	The BFP should be associated with an increase in the group size of the municipal population that prefers public hospital care spending to primary care spending.
H_4:	The size of the BFP correlation with decreased allocations to primary care and increased allocations to hospital care is larger for municipalities with a higher percentage of BFP coverage.	The BFP should be associated not only with an increase in the size of the group that prefers hospital spending, but also with increased policy leverage for this group due to increased relative preference asymmetry.

4.1.2 Complementary and Countervailing Arguments

The principal hypothesis above, H_1, suggests that municipal BFP coverage should be associated with decreases in municipal funds spent on public primary care services. The logic behind my argument is founded on exchange value principles of consumer behavior. If a set of publicly- and privately-produced goods are substitutes, an income boost that allows poor consumers to procure more of the privately-produced good should, resultantly, decrease these consumers' demands for the publicly-produced good. Chapter 3 suggests this is the case for poor voters that receive BFP transfers. Since public primary care services are non-excludable, decreased demand for the non-excludable services by BFP recipients could have

adverse consequences for those who continue to rely exclusively on the public services (like poor voters who do not receive BFP).

There are, however, some countervailing predictions that derive from exchange theory logic, as well as from the public finance literature. These complicate the prediction articulated in H_1. My prediction is predicated on the assumption that service provision prior to the BFP income shock was optimal and that there was no unmet health demand. However, empirical research suggests that latent or unmet health care demand exists in Brazil, especially among the poor. The same study suggests that public consumption remains inelastic to income while private consumption is elastic (Cataife and Courtemanche, 2014). That is, small amounts of additional income should lead to additional consumption of private health resources to supplement a constant level of consumption of public health services.[2] If so, then the shock from the BFP should lead to an increase in private consumption of primary care goods without altering existing public primary care consumption. In this case, BFP assignment should not result in decreased group size of the primary care-demanding group and levels of primary care provision should not be associated with increases in the BFP coverage in a municipality. Effectively, then, H_1 tests whether the substitution effect (substituting private services for public services) overwhelms the income effect (increased income increases

[2]The same study suggests that income shocks may be sufficient to decrease consumption of public health services, but only if the income shock is sufficiently large to fund a private health care plan, rather than just occasional supplementary private services. It is unlikely, however, that BFP assignment switches many primary care consumers entirely to the private market. Only about 20% of Brazilians can afford to buy a private plan; empirical research confirms that consumption of these plans is highly correlated with wealth (Cataife and Courtemanche, 2014). We know from national survey estimates from 2006 that exceedingly few program recipients lie anywhere near this 80^{th} percentile of wealth cutoff and that the vast majority of BFP recipients are in the poorest two quintiles of the wealth distribution (Soares, Ribas and Osório, 2010). The cost of a private health care plan for the typical family in a medium-sized city in Brazil is about 650 *reais* per month (see http://www.liveinbrazil.org/the-cost-of-living-in-brazil-the-real-price/). The BFP is targeted at families that earn no more than 140 *reais* per capita each month. For a family of four, this would mean a monthly income of approximately 560 *reais*. In 2013, the average monthly stipend from the Program was about 152 *reais* per family (see http://www.theguardian.com/global-development-professionals-network/2013/nov/05/bolsa-familia-brazil-cash-transfer-system). Families in abject poverty (with per capita incomes of no more than 70 *reais*) typically receive more than families with this second income tier, so the average stipend is probably an overestimate of the typical stipend for these second tier families. But even if we add the average stipend of 152 *reais* to the maximum allowable income for a typically-sized second tier recipient family, we end up with a total family income of about 712 *reais* per month—enough for that family to purchase a private health plan, provided that they are willing to devote almost their entire income to that sole purpose. This is not likely (and is even less likely-to-impossible if the family falls below the maximum allowable income).

total consumption of services).

Furthermore, the logic of government finance operates differently from that of individual market consumption. An individual who receives a positive income shock like the BFP may use the funds to substitute private consumption of primary care for public provision of these services. However, public finance research suggests that governments are unlikely to respond to such a shift by decreasing funding for existing services. That is, increased demand for hospital care may increase expenditures on hospital care through new spending, but money allocated toward primary care in the past should be "stuck" where it is. In the public finance literature, this has been termed the "fly-paper effect." It describes a tendency for public expenditures to "stick" where ever they first hit (Courant, Gramlich and Rubinfeld, 1978). Empirically, it says, political figures accountable to voters are not prone to simple compensatory substitution. For example, there exists considerable evidence that increased federal transfers to local governments do not decrease local taxation; rather they increase local expenditure (Hines and Thaler, 1995; Turnbull, 1998; Wyckoff, 1988; Bae and Feiock, 2004; Fisher, 1982; Courant, Gramlich and Rubinfeld, 1978).

One of various proposed explanations for the empirical anomaly is that it may be due to a specific type of bounded-rationality among voters—distortions in mental accounting (Thaler, 1999). A particularly relevant distortion seems to be the fact that losing something one expects to receive carries more cognitive weight than does gaining something that one did not expect to receive (Tversky and Kahneman, 1991). This explanation is consistent with the fact that the result seems to hold even with respect to windfall grants received by private actors, rather than by the local government (Hines and Thaler, 1995; Jacoby, 2002). If the fly-paper effect prevails, we would not expect to see a decrease in local service spending despite the influx of federal capital. By this logic, the BFP should not be correlated with decreased primary care spending. In this scenario, H_1 would be incorrect.

The empirical implications of both of the two scenarios described above (inelastic public consumption at the individual level and inelastic public spending at the government level) can be summarized by the following alternative hypothesis.

Table 4.2: Alternative Hypothesis to H_1

	Empirical Prediction	Mechanism
H_0:	Municipal primary care spending is unrelated to the percentage of the population that is assigned to the BFP at the municipal level.	If the BFP increases private primary care consumption without decreasing its public consumption, or if municipal funds allocated to primary care are "stuck" where they are, then BFP coverage at the municipal level should not be related to public funding of primary care.

4.2 Operationalization and Empirical Strategy

4.2.1 Dependent Variable

The previous section outlines expectations for consumption shift after income shock. To evaluate the validity of these hypotheses, it is necessary to examine a measure of service supply that directly captures the actions and intentions of local mayors in terms of supply-shift. Mayors are the budgetary-proposing actor in local Brazilian politics. Other local politicians add amendment proposals, but the mayor is both the starting and finishing player (Oliveira, 2009, p. 9-10). Therefore, the most direct observation of supply-response to usage change with respect to the public primary care system is local budgetary per capita expenditures on primary care. I use (the log of) this measure as the dependent variable.

4.2.2 Estimation Strategy

I employ multivariate control to try to isolate the effect of the BFP coverage on mayoral spending decisions. Since one key determinate of primary care expenditures will be the total size of the municipal budget, I control for municipal per capita revenues. I also control for the size of the taxable base by including the municipal GDP per capita as an independent variable. Since there may be economies of scale in provision associated with population size, as well as different challenges in provision in urban and rural communities, I control for both population size and the percentage of that population living in rural conditions.

Finally, I control for two characteristics of municipal health provision that can greatly alter the size of total health expenditures in a municipality. These include the percentage of the population that is covered by the Family Health Program (a community-based model of primary care, which receives formulaic financial support from the federal government) and whether the municipality has at least one hospital, since this leads to split priorities between primary care and high complexity spending. Note that I use Ordinary Least Squares instead of Poisson regression because I look at spending level per capita (non-integer values), so instead I use the log of the spending per capita variable as the dependent variable.

The effects of the BFP on individual health service consumption should be fairly immediate following assignment to the BFP. However, mayoral learning regarding preference- or consumption-shift may take time after the start of the Program (in late 2003). Therefore, I execute separate cross-sectional analyses of the relationship between municipal BFP coverage and municipal spending on primary care for each year from 2004-2010 to show any evolution of the relationship over time since the start of the Program.

Despite efforts to use statistical control for observable covariates, the BFP could still be correlated with any number of unobserved covariates. This could produce biased estimates of the causal effect. To address this concern, I turn to an identification strategy that tries to separate the part of the variation in municipal BFP coverage rates that is exogenously assigned. I first subclassify municipalities into ten subgroups of official BFP target rates used to guide assignment. I then repeat the multivariate analysis within subgroups and compute subgroup-weighted coefficient averages. The degree to which the BFP is correlated with unobservables should be captured by the target rates creating the subclasses (Imai and Van Dyk, 2004; Zucco, 2013). Deviations from target rates result prinicipally from assignment noise from the fluctuating incomes of the poor (Soares, Ribas and Osório, 2010). Thus, within-subclass assignment variation should be exogenous.

4.2.3 Data

The municipal budgetary expenditure data come from the National Treasury of Brazil, which maintains a record of annual municipal accounting. Before 2004, these records include only large subfunctions of government, so it is impossible to distinguish primary care spending from hospital service spending. Therefore, I rely on the data available since 2004, which further subdivide health expenditures into categories that allow for the direct assessment of primary care allocations. Fortunately, since the BFP was first implemented in the last months of 2003, this means the data are sufficient to provide a snapshot of the correlation between program assignment at the Program's start and primary care service spending.

Using this data I show that the Program's assignment is not especially correlated with primary care spending when the Program began. This provides more evidence that the correlation, which gradually increases in size over the years since the Program's initiation, was induced by the Program rather than spuriously correlated with pre-treatment covariates. Data on municipal revenues come from the same source. The remainder of the data come from DATASUS (the health care database maintained by the Brazilian Ministry of Health), IPEA (*Instituto de Pesquisa Econômica Aplicada*) and IBGE (*Instituto Brasileiro de Geografia e Estatística*).

4.3 Results

4.3.1 Multivariate Control

The results of the year-by-year multivariate control design appear in Tables 4.3 and 4.4. The results suggest that municipal revenues per capita are a strong positive predictor of per capita primary care expenditures. This relationship appears largely static over time. This suggests the relative efficiency of spending on primary care compared to other budgetary expenditures has not changed. Once controlling for total municipal revenues, the wealth of a municipality is not an especially strong or consistent predictor of spending on primary care. Population size is negatively associated with spending on primary care. This is consistent

with economies of scale in primary care provision. More rural areas tend to spend more on primary care per capita than do more urban municipalities, again suggesting population density is a relevant factor in determining spending efficiency of per capita non-excludable services.

The types of health services offered in a municipality are relevant predictors of spending, as well. In particular, those municipalities in which a larger percentage of the population is served by the Family Health Program spend more on primary care on average. This makes sense since the Family Health Program has been the preferred model for primary care service provision in Brazil since the late 1990s and its funding is secured by federal transfers to the municipality. Having at least one hospital in the municipality is associated with lower spending on primary care, providing some support for the concern that hospitals and primary care have competing public funding interests and that municipalities with hospitals foot more-than-their-share of hospital bills (Machado, 2009). These relationships between specific service coverage and spending are largely static over time.

The focal variable, BFP coverage, appears to be increasingly negatively associated with public per capita primary care spending over time. This provides initial support for H_1 and suggests that municipal spending on primary care services in Brazil is at least somewhat elastic (contrary to the expectation in H_0). The BFP coefficients for each year from 2004-2010 appear with 95% confidence intervals in Figure 4.1 (the full numeric results are reported in Tables 4.3 and 4.4).

Table 4.3: OLS: Dependent Variable—Log Primary Care Spending per Capita

Variable	**2004**	**2005**	**2006**	**2007**
	(Std Err)	(Std Err)	(Std Err)	(Std Err)
Bolsa Família Coverage (Sq Rt)	-0.040***	-0.042***	-0.100***	-0.112***
	(0.013)	(0.014)	(0.013)	(0.013)
Municipal Revenue and Transfers (Log)	0.593***	0.622***	0.619***	0.520***
	(0.053)	(0.058)	(0.055)	(0.056)
Municipal GDP per cap (Log)	0.064*	0.038	-0.062*	-0.039
	(0.034)	(0.037)	(0.037)	(0.035)
Population (Log)	-0.006	-0.023	-0.064***	-0.052***
	(0.019)	(0.020)	(0.019)	(0.019)
Percent Pop Living in Rural Conditions	0.003***	0.003***	0.002**	0.002***
	(0.001)	(0.001)	(0.001)	(0.001)
Family Health Program Coverage	0.003***	0.003***	0.003***	0.003***
	(0.000)	(0.000)	(0.000)	(0.000)
Number of Hospitals ≥ 1 (Dummy)	0.002	-0.074**	-0.074**	-0.101***
	(0.035)	(0.036)	(0.033)	(0.035)
Intercept	-0.234	0.030	1.756***	2.189***
	(0.423)	(0.461)	(0.458)	(0.504)
N	5,127	5,215	5,496	5,214
R^2	0.110	0.117	0.141	0.121

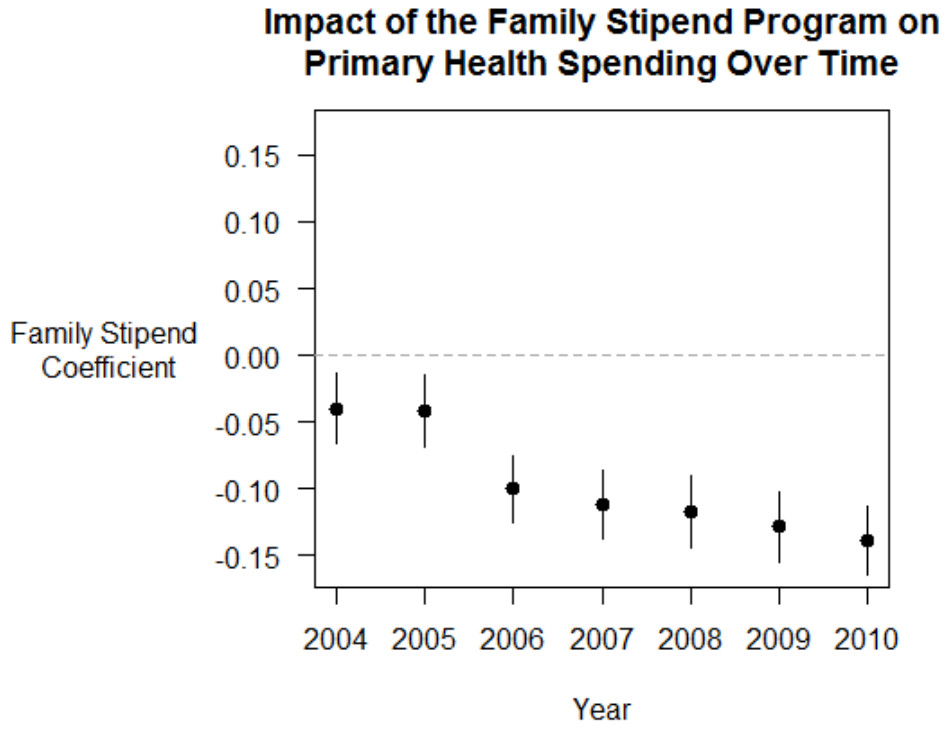
***0.01 α-level; **0.05 α-level; *0.1 α-level

Table 4.4: Table 4.3 Continued

Variable	**2008**	**2009**	**2010**
	(Std Err)	(Std Err)	(Std Err)
Bolsa Família Coverage (Sq Rt)	-0.117***	-0.128***	-0.139***
	(0.014)	(0.013)	(0.013)
Municipal Revenue and Transfers (Log)	0.559***	0.505***	0.499***
	(0.059)	(0.057)	(0.057)
Municipal GDP per cap (Log)	-0.042	-0.036	-0.056
	(0.038)	(0.038)	(0.038)
Population (Log)	-0.074***	-0.074***	-0.096***
	(0.020)	(0.019)	(0.019)
Percent Pop Living in Rural Conditions	0.003***	0.003***	0.004***
	(0.001)	(0.001)	(0.001)
Family Health Program Coverage	0.002***	0.002***	0.002***
	(0.001)	(0.001)	(0.001)
Number of Hospitals ≥ 1 (Dummy)	-0.090**	-0.130***	-0.082**
	(0.036)	(0.035)	(0.035)
Intercept	2.230***	2.758***	3.263***
	(0.520)	(0.498)	(0.511)
N	5,007	5,431	5,351
R^2	0.138	0.133	0.143

***0.01 α-level; **0.05 α-level; *0.1 α-level

Figure 4.1: *Bolsa Família* Effects on Primary Care Spending



4.3.2 Subclassification on Target Rates

The results from the analysis that subclassifies municipalities on BFP target rates before executing the multivariate analysis are consistent with those from the pooled model above. Revenues are a similarly strong predictor of primary care spending in terms of size, direction and statistical signficance. Municipal GDP continues to be of inconsistent statistical significance, though, in this analysis it remains negative in direction. The direction of the coefficients makes logical sense, since wealthier municipalities are likely to have larger populations enrolled in private plans that serve as substitutes for public primary care. The results for population size, rural conditions, Family Health Program coverage, and the presence of a hospital are effectively identical to the previous analysis. The numeric results are summarized in Tables 4.5 and 4.6.

The BFP coverage coefficient shows the same general trend over time as in the previous

analysis, but the temporal movement seems more gradual (see Figure 4.2). In this model, the first year of the BFP (2004) assignment was not correlated with primary care spending. This suggests that it is unlikely that pre-treatment variables are responsible for the correlation between the BFP and spending in later years. From 2004, the relationship between the Program and spending on primary care grows increasingly negative with time, only reaching statistical significance in later years as the effect becomes large. Figure 4.3 compares predicted per capita primary spending rates across BFP municipal assignment values for 2004 and 2010. In 2004, there is effectively no difference in predicted spending rates between a municipality with 5% BFP coverage and another with 95% coverage. By 2010, however, municipalities with low BFP coverage have increased their spending on primary care significantly (by a factor of over 100%), while municipalities with very high coverage have effectively stagnated (in nominal terms) in terms of primary care expenditures per capita over the same period.

Table 4.5: Subclassified OLS: Dependent Variable—Log Primary Care Spending per Capita

Variable	**2004**	**2005**	**2006**	**2007**
	(Std Err)	(Std Err)	(Std Err)	(Std Err)
Bolsa Família Coverage (Sq Rt)	0.003	0.023	-0.011	-0.013
	(0.019)	(0.020)	(0.020)	(0.022)
Municipal Revenue and Transfers (Log)	0.609***	0.639***	0.611***	0.508***
	(0.058)	(0.065)	(0.061)	(0.059)
Municipal GDP per cap (Log)	-0.015	-0.012	-0.116***	-0.068*
	(0.039)	(0.042)	(0.039)	(0.036)
Population (Log)	0.016	0.012	-0.046**	-0.031
	(0.023)	(0.024)	(0.022)	(0.022)
Percent Pop Living in Rural Conditions	0.002***	0.002***	0.002***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
Family Health Program Coverage	0.002***	0.003***	0.003***	0.004***
	(0.000)	(0.000)	(0.000)	(0.001)
Number of Hospitals ≥ 1 (Dummy)	-0.026	-0.105***	-0.099***	-0.122***
	(0.036)	(0.036)	(0.034)	(0.036)
Intercept	-0.033	-0.247	1.545***	1.784***
	(0.490)	(0.535)	(0.513)	(0.568)
N	5,127	5,215	5,496	5,214

***0.01 α-level; **0.05 α-level; *0.1 α-level

Table 4.6: Table 4.5 Continued

Variable	**2008**	**2009**	**2010**
	(Std Err)	(Std Err)	(Std Err)
Bolsa Família Coverage (Sq Rt)	-0.032	-0.072***	-0.090***
	(0.023)	(0.028)	(0.027)
Municipal Revenue and Transfers (Log)	0.552***	0.479***	0.527***
	(0.064)	(0.062)	(0.062)
Municipal GDP per cap (Log)	-0.057	-0.040	-0.075*
	(0.042)	(0.042)	(0.042)
Population (Log)	-0.054**	-0.064***	-0.065***
	(0.023)	(0.022)	(0.022)
Percent Pop Living in Rural Conditions	0.004***	0.003***	0.004***
	(0.001)	(0.001)	(0.001)
Family Health Program Coverage	0.003***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)
Number of Hospitals ≥ 1 (Dummy)	-0.107***	-0.133***	-0.104***
	(0.037)	(0.035)	(0.036)
Intercept	1.787***	2.561***	2.535***
	(0.586)	(0.573)	(0.586)
N	5,007	5,431	5,351

***0.01 α-level; **0.05 α-level; *0.1 α-level

Figure 4.2: *Bolsa Família* Effects on Primary Care Spending from Subclassification Analysis

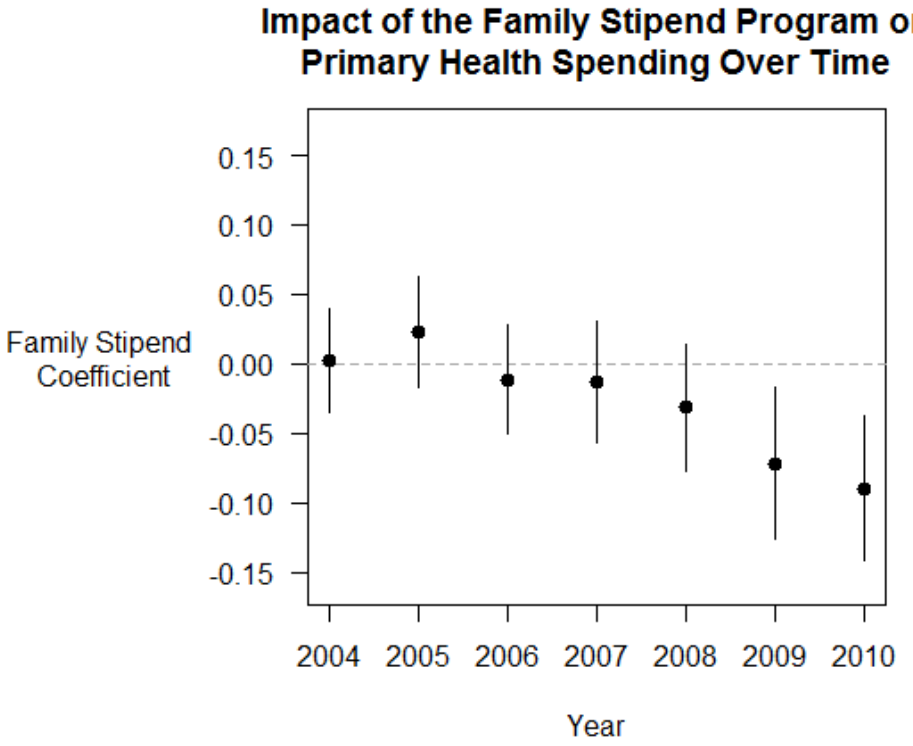
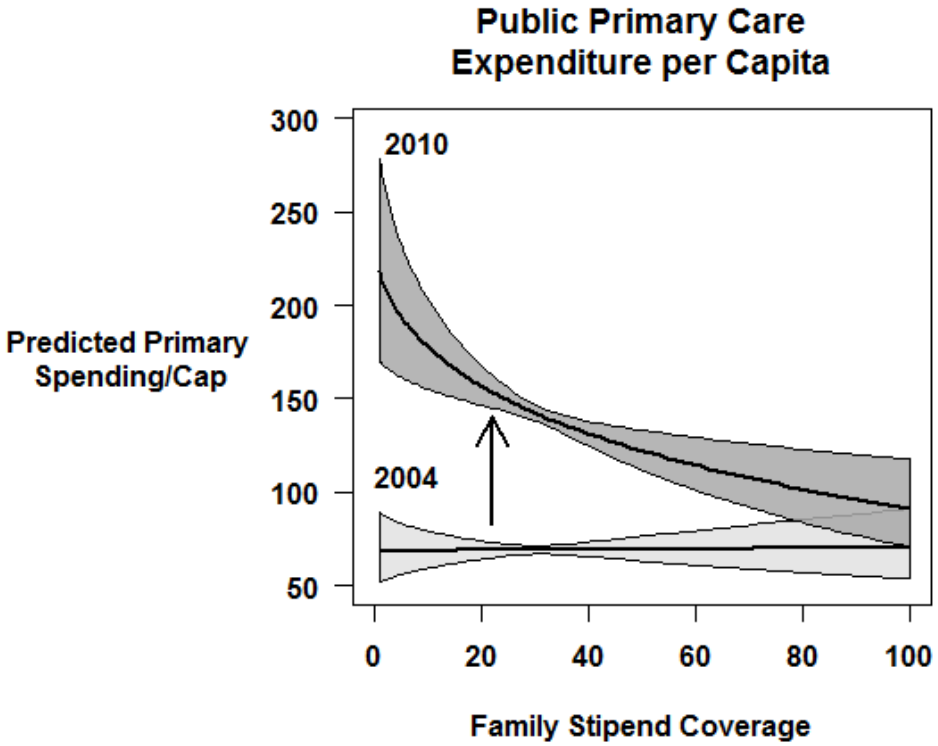


Figure 4.3: Predicted Primary Health Expenditures



4.4 Discussion

The results suggest that the net effect of the income shock induced by the BFP is a shift in municipal spending away from primary health care in municipalities where many residents receive direct federal transfers. What is the mechanism driving these results? These results could be explained by substitution logic alone in consumption theory. That is, when individuals have more money in pocket to procure private services, the demand for public services decreases and so should public service provision. Alternatively, the results could be explained by an increase in efficiency in primary care spending over time (though there is no clear *a priori* reason to believe such increasing efficiency should be correlated with municipal BFP coverage).

In order to believe the explanation for the negative association between public primary care spending and BFP coverage that was presented in Chapters 2 and 3, one must believe

several things. First, I must show that the shift in spending away from primary care does not result solely from efficiency gains, but rather actually produces decreased access to public primary care services. Furthermore, in my story, the size and influence of the hospital care-preferring group increases with municipal BFP coverage as the size and influence of the public primary care-preferring group decreases. If this explanation is accurate, I should be able to show that the money lost from public primary care expenditures has migrated to public spending on hospital services. Finally, I must show that the migration of public health funds results not only from the decreased size of the primary care-demanding group, but also from the decreased policy influence of this group due to to increasingly lopsided health service preferences for the recipient poor. It is, therefore, necessary to test these additional implications of my argument to be able to distinguish results consistent with my claims regarding group size and relative preference asymmmetry from those caused by simple substitution or efficiency gain. In this section, I further explore this differentiation by examining hypotheses H_2, H_3, and H_4.

4.4.1 Effects of the BFP on Access to Public Primary Care Clinics

Even after showing that the BFP is associated with downward shifts in mayoral expenditures on primary health care, it is not self-evident what this means in terms of service provision. Perhaps decreases in spending reflect increased spending efficiency rather than a loss of service access. The hypothesis H_2 predicts that the recorded decreases in public primary care spending associated with municipal coverage of the BFP result in decreased access to public primary care services. That is, the hypothesis predicts the result cannot be fully explained by simple efficiency gains in the provision of existing primary care services. In the next analysis I treat per capita public primary care spending as an intervening variable between the independent variable of interest, BFP coverage, and a measure of the provision of primary care services, the number of primary care clinics in a municipality per 1,000 people in the population. A diagram of the intervening variable relationship follows.

Bolsa Família coverage		primary care spending		primary care clinics
{Z}	$\longrightarrow$	{S}	$\longrightarrow$	{Y}

Using the method of mediated regression independently proposed by Judd and Kenny and Sobel (Judd and Kenny, 1981; Sobel, 1982), I first calculate the direct effects (D) of public spending, BFP coverage, and all the control variables on the number of health clinics relative to population size, as in Equation 4.1 below. I then calculate a second regression shown in Equation 4.2, which leaves out the public spending variable and allows the remaining covariates to absorb the total effects (T) including both the direct effects from Equation 4.1 and any indirect effects (I) that operate through the absent spending variable. This allows the researcher to compute the size of the indirect effects of each covariate through the intervening mechanism of public spending as $\beta^{\{I\}} = \beta^{\{T\}} - \beta^{\{D\}}$. This method will help to assess not only the plausibility of the correlation between the BFP and primary care provision, but the plausibility of the causal explanatory sequence proposed in this dissertation.

$$Y = \beta_0^{\{D\}} + \beta_1^{\{D\}} S + \beta_2^{\{D\}} Z + \beta_3^{\{D\}} X + \epsilon^{\{D\}} \quad (4.1)$$

$$Y = \beta_0^{\{T\}} + \beta_2^{\{T\}} Z + \beta_3^{\{T\}} X + \epsilon^{\{T\}} \quad (4.2)$$

The direct effects of the BFP on the per capita number of primary care clinics from the mediated regression results appear in Tables 4.7 and 4.8. The most noteworthy observation is that in the direct effect stage, once controlling for the intervening variable, primary care spending per capita, the BFP has no statistically significant direct relationship with clinic distribution. This is what we would expect if the main mechanism through which the BFP influences clinic provision is through municipal primary care funding.

The indirect effects of the BFP appear in Table 4 with bootstrapped standard errors. These represent the relationship between the BFP and the number of primary care clinics per 1,000 in the population that operates through its influence on primary care spending. It is worth noting that in 2004 and 2005, during the first few years of the Program's existence,

there is no correlation between BFP assignment and the distribution of primary care clinics across municipalities. A negative relationship between the BFP and clinics, mediated by primary care spending, grows with time, reaching statistical significance in later years. There seems to be a steady, increasingly negative trend to the relationship, with the exception of 2008. It is not clear why 2008 would be excepted from the spending trend, though it may be worth noting that 2008 was a municipal election year and health spending may tend to surge or recover under immediate electoral pressure. The temporal trend of the indirect BFP coefficient appears in Figure 4.4 (visualized here as the relationship with primary care clinics per 100,000 in the population for ease of interpretation).

Table 4.7: Mediated Regression Direct Effects: Dependent Variable—Square Root Primary Care Clinics per 1,000 in Population

Variable	**2004**	**2005**	**2006**	**2007**
	(Std Err)	(Std Err)	(Std Err)	(Std Err)
Bolsa Família Coverage (Sq Rt)	0.001	-0.002	-0.003	0.004*
	(0.002)	(0.002)	(0.002)	(0.002)
Municipal Revenue and Transfers (Log)	0.064***	0.080***	0.079***	0.070***
	(0.010)	(0.010)	(0.010)	(0.009)
Municipal GDP per cap (Log)	-0.007	-0.008	-0.016**	-0.011*
	(0.006)	(0.007)	(0.007)	(0.006)
Population (Log)	-0.039***	-0.038***	-0.033***	-0.033***
	(0.003)	(0.004)	(0.003)	(0.003)
Percent Pop Living in Rural Conditions	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Family Health Program Coverage	0.002***	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
Number of Hospitals ≥ 1 (Dummy)	0.002	0.008	0.002	0.002
	(0.006)	(0.006)	(0.006)	(0.006)
Log Primary Care Spending per cap	0.001	0.000	0.004	0.005**
	(0.003)	(0.002)	(0.002)	(0.002)
Intercept	0.413***	0.285***	0.287***	0.275***
	(0.076)	(0.081)	(0.083)	(0.084)
N	5,128	5,216	5,497	5,215

***0.01 α-level; **0.05 α-level; *0.1 α-level

Table 4.8: Table 4.7 Continued

Variable	**2008**	**2009**	**2010**
	(Std Err)	(Std Err)	(Std Err)
Bolsa Família Coverage (Sq Rt)	0.001	0.003	0.001
	(0.002)	(0.002)	(0.002)
Municipal Revenue and Transfers (Log)	0.088***	0.072***	0.062***
	(0.010)	(0.010)	(0.010)
Municipal GDP per cap (Log)	-0.031***	-0.022***	-0.016**
	(0.006)	(0.007)	(0.007)
Population (Log)	-0.028***	-0.036***	-0.040***
	(0.003)	(0.003)	(0.003)
Percent Pop Living in Rural Conditions	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)
Family Health Program Coverage	0.002***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)
Number of Hospitals ≥ 1 (Dummy)	0.005	0.006	0.008
	(0.006)	(0.006)	(0.006)
Log Primary Care Spending per cap	0.003	0.006**	0.004*
	(0.002)	(0.002)	(0.002)
Intercept	0.277***	0.389***	0.440***
	(0.084)	(0.087)	(0.089)
N	5,007	5,432	5,352

***0.01 α-level; **0.05 α-level; *0.1 α-level

Table 4.9: Mediated Regression Indirect Effects: Dependent Variable—Square Root Primary Care Clinics per 1,000 in Population

Variable	**2004**	**2005**	**2006**	**2007**
	(Std Err)	(Std Err)	(Std Err)	(Std Err)
Bolsa Família Coverage (Sq Rt)	-0.0001	0.0000	-0.0004	-0.0005**
	(0.0001)	(0.0001)	(0.0003)	(0.0003)
Municipal Revenue and Transfers (Log)	0.0008	-0.0003	0.0024	0.0024**
	(0.0016)	(0.0016)	(0.0016)	(0.0013)
Municipal GDP per cap (Log)	0.0001	0.0000	-0.0002	-0.0002
	(0.0002)	(0.0001)	(0.0002)	(0.0002)
Population (Log)	0.0000	0.0000	-0.0002	-0.0002*
	(0.0001)	(0.0001)	(0.0002)	(0.0002)
Percent Pop Living in Rural Conditions	0.0000	0.0000	0.0000	0.0000*
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Family Health Program Coverage	0.0000	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Number of Hospitals ≥ 1 (Dummy)	0.0000	0.0000	-0.0003	-0.0005*
	(0.0001)	(0.0002)	(0.0002)	(0.0003)
Intercept	-0.0003	0.0000	0.0068	0.0100**
	(0.0014)	(0.0012)	(0.0050)	(0.0058)
N	5,128	5,216	5,497	5,215

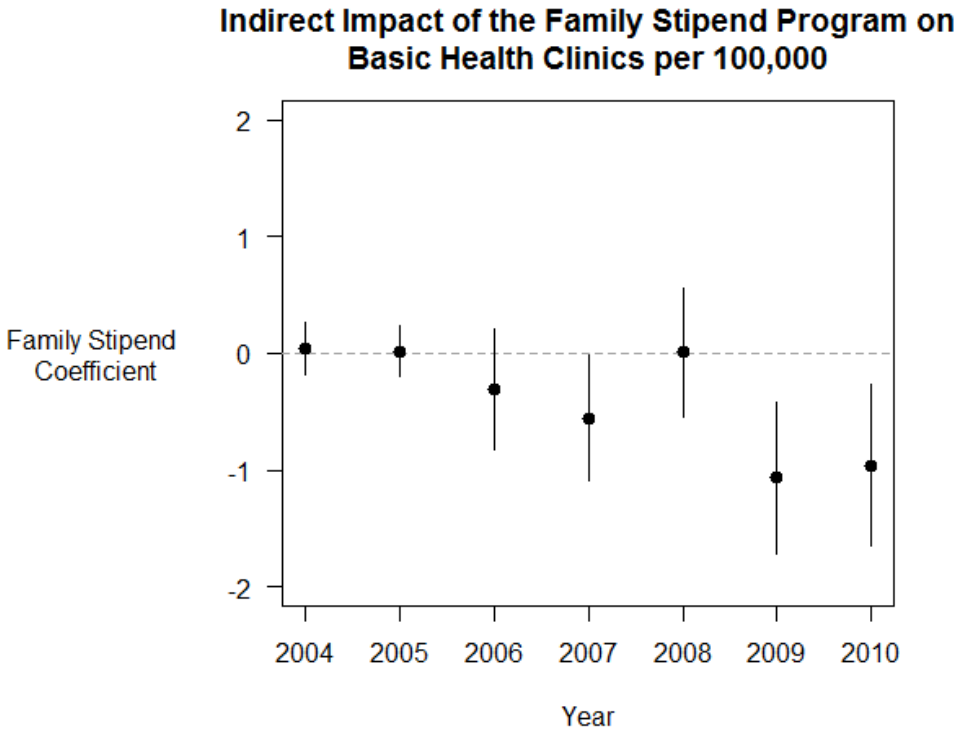
***0.01 α-level; **0.05 α-level; *0.1 α-level

Table 4.10: Table 4.9 Continued

Variable	**2008**	**2009**	**2010**
	(Std Err)	(Std Err)	(Std Err)
Bolsa Família Coverage (Sq Rt)	-0.0003	-0.0007**	-0.0006*
	(0.0003)	(0.0003)	(0.0004)
Municipal Revenue and Transfers (Log)	0.0014	0.0028**	0.0022*
	(0.0013)	(0.0013)	(0.0013)
Municipal GDP per cap (Log)	-0.0001	-0.0002	-0.0002
	(0.0002)	(0.0003)	(0.0002)
Population (Log)	-0.0002	-0.0004**	-0.0004*
	(0.0002)	(0.0002)	(0.0003)
Percent Pop Living in Rural Conditions	0.0000	0.0000**	0.0000*
	(0.0000)	(0.0000)	(0.0000)
Family Health Program Coverage	0.0000	0.0000**	0.0000*
	(0.0000)	(0.0000)	(0.0000)
Number of Hospitals ≥ 1 (Dummy)	-0.0002	-0.0007	-0.0004
	(0.0003)	(0.0004)	(0.0003)
Intercept	0.0058	0.0155**	0.0142*
	(0.0056)	(0.0076)	(0.0086)
N	5,007	5,432	5,352

***0.01 α-level; **0.05 α-level; *0.1 α-level

Figure 4.4: Mediated Regression



4.4.2 Where is the money going?

Though this chapter has, thus far, shown that the start of the BFP is associated with decreased municipal government commitment to primary health care where program coverage is high, it has yet to indicate where the emigrating funds relocate. Since certain levels of health spending by the municipality are constitutionally-mandated (Pierce, 2013), it stands to reason that the emigrating health funds are being transferred to other services within the health sector, rather than being allocated to a different sector entirely. The hypothesis H_3 suggests that public hospital spending should increase in conjunction with municipal BFP coverage due to increases in group size for the hospital care-preferring group. Below I provide evidence that suggests that the missing health funds from primary care have been increasingly re-routed to hospital care expenditures where BFP coverage is high.

In order to test this, I repeat the multivariate control analysis for other forms of health spending. Tables 4.11 and 4.12 provide results from such an analysis with respect to a

per capita hospital spending dependent variable; Tables 4.13 and 4.14 provides results with respect to total per capita health expenditures (aggregating over primary care, hospital care, and administrative costs of health monitoring). Finally, Figure 4.5 plots the annual coefficients for the BFP with respect to each of these types of health spending side-by-side (including the relationship with public primary care spending for comparison). The figure shows that the BFP maintained a relatively uncorrelated relationship with total health spending over time, even while its association with primary care grew negative. The figure also shows that the association between the BFP and hospital care grew in a positive direction commensurately over the same time period.

Table 4.11: OLS: Dependent Variable—Log Hospital Spending per Capita

Variable	**2004**	**2005**	**2006**	**2007**
	(Std Err)	(Std Err)	(Std Err)	(Std Err)
Bolsa Família Coverage (Sq Rt)	0.075***	0.086***	0.105***	0.108***
	(0.015)	(0.015)	(0.015)	(0.016)
Municipal Revenue and Transfers (Log)	0.561***	0.527***	0.596***	0.688)***
	(0.059)	(0.065)	(0.066)	(0.067)
Municipal GDP per cap (Log)	-0.030	0.010	0.049	0.064
	(0.038)	(0.042)	(0.044)	(0.041)
Population (Log)	0.150***	0.139***	0.175***	0.190***
	(0.021)	(0.023)	(0.023)	(0.023)
Percent Pop Living in Rural Conditions	-0.002***	-0.003***	-0.003***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
Family Health Program Coverage	0.000	0.001*	0.001**	0.001**
	(0.000)	(0.001)	(0.001)	(0.001)
Number of Hospitals ≥ 1 (Dummy)	0.136***	0.184***	0.232***	0.281***
	(0.039)	(0.040)	(0.039)	(0.042)
Intercept	-1.834***	-1.975***	-3.357***	-4.353***
	(0.472)	(0.519)	(0.543)	(0.605)
N	5,127	5,215	5,496	5,214
R^2	0.037	0.036	0.046	0.056

***0.01 α-level; **0.05 α-level; *0.1 α-level

Table 4.12: Table 4.11 Continued

Variable	**2008**	**2009**	**2010**
	(Std Err)	(Std Err)	(Std Err)
Bolsa Família Coverage (Sq Rt)	0.131***	0.113***	0.097***
	(0.017)	(0.017)	(0.016)
Municipal Revenue and Transfers (Log)	0.563***	0.553***	0.707***
	(0.073)	(0.071)	(0.071)
Municipal GDP per cap (Log)	0.162***	0.137***	0.044
	(0.047)	(0.047)	(0.048)
Population (Log)	0.193***	0.204***	0.274***
	(0.025)	(0.024)	(0.024)
Percent Pop Living in Rural Conditions	-0.004***	-0.004***	-0.005***
	(0.001)	(0.001)	(0.001)
Family Health Program Coverage	0.002***	0.002***	0.003***
	(0.001)	(0.001)	(0.001)
Number of Hospitals ≥ 1 (Dummy)	0.354***	0.356***	0.368***
	(0.044)	(0.043)	(0.044)
Intercept	-4.534***	-4.244***	-5.249***
	(0.645)	(0.619)	(0.640)
N	5,007	5,431	5,351
R^2	0.064	0.069	0.087

***0.01 α-level; **0.05 α-level; *0.1 α-level

Table 4.13: OLS: Dependent Variable—Log Health Spending per Capita

Variable	**2004**	**2005**	**2006**	**2007**
	(Std Err)	(Std Err)	(Std Err)	(Std Err)
Bolsa Família Coverage (Sq Rt)	0.019***	0.012***	0.001	-0.005
	(0.007)	(0.004)	(0.004)	(0.004)
Municipal Revenue and Transfers (Log)	0.821***	0.839***	0.847***	0.822***
	(0.026)	(0.018)	(0.016)	(0.016)
Municipal GDP per cap (Log)	0.011	-0.003	-0.029***	-0.020**
	(0.016)	(0.012)	(0.011)	(0.010)
Population (Log)	0.027***	0.011*	-0.001	0.001
	(0.009)	(0.006)	(0.005)	(0.005)
Percent Pop Living in Rural Conditions	-0.002***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Family Health Program Coverage	0.002***	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
Number of Hospitals ≥ 1 (Dummy)	0.018	0.006	0.037***	0.013
	(0.017)	(0.011)	(0.009)	(0.010)
Intercept	-0.919***	-0.677***	-0.323**	-0.182
	(0.205)	(0.146)	(0.130)	(0.146)
N	5,127	5,215	5,496	5,214
R^2	0.358	0.565	0.631	0.578

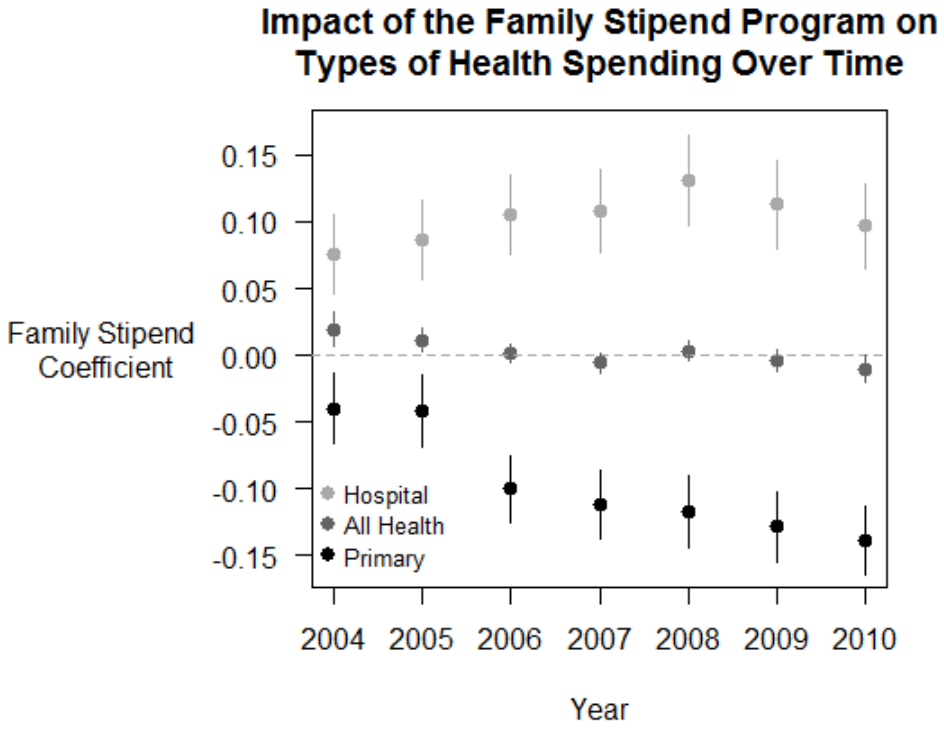
***0.01 α-level; **0.05 α-level; *0.1 α-level

Table 4.14: Table 4.13 Continued

Variable	**2008**	**2009**	**2010**
	(Std Err)	(Std Err)	(Std Err)
Bolsa Família Coverage (Sq Rt)	0.003	-0.004	-0.010**
	(0.004)	(0.004)	(0.005)
Municipal Revenue and Transfers (Log)	0.839***	0.786***	0.820***
	(0.016)	(0.018)	(0.022)
Municipal GDP per cap (Log)	0.004	0.023**	-0.003
	(0.010)	(0.012)	(0.015)
Population (Log)	-0.003	-0.006	0.001
	(0.005)	(0.006)	(0.007)
Percent Pop Living in Rural Conditions	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)
Family Health Program Coverage	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)
Number of Hospitals ≥ 1 (Dummy)	0.008	0.010	0.028**
	(0.010)	(0.011)	(0.013)
Intercept	-0.492***	-0.148	-0.225
	(0.141)	(0.154)	(0.197)
N	5,007	5,431	5,351
R^2	0.623	0.533	0.426

***0.01 α-level; **0.05 α-level; *0.1 α-level

Figure 4.5: Migrating Health Funds



4.4.3 Distinguishing *Group Size* from *Relative Preference Asymmetry*

The evidence presented thus far suggests that the BFP is associated with shifting municipal health provision priorities. In particular, it suggests that funds migrate from primary care spending to hospital spending in the presence of BFP coverage. This is consistent with the expectations established in Chapter 3 by the voting behavior findings. The comparative statics presented in Chapter 2 elaborate on the mechanisms I argue underlie the shift.

Specifically, Chapter 2 shows that as the group that prefers primary care spending decreases as a percentage of the voting population, expenditures allocated to primary care decrease approximately proportionately. I call this the effect of *group size*. However, Chapter 2 also shows that group size is not the only relevant factor in spending allocation decisions between competing services. Different groups' preferences have different weights with respect to policy influence and these weights are determined by *relative preference asymmetry* across

groups. Groups that place considerably more weight on one service than the other "weigh" more than groups that weakly value one service to another, even if the latter group has higher demand for their preferred service than the former group.

Identifying whether only one or both of these mechanisms is responsible for the spending shift identified in this chapter is difficult. Both propositions imply the BFP should be associated with the migration of health funds away from primary care and toward hospital care because (as Chapter 3 shows) it decreases both the *group size* and the *relative preference asymmetry* of the primary care-preferring group. The conventional notion of the "substitution effect" from consumer theory aligns with the *group size* prediction. That is, as disposable income increases, private substitutes for public services become more accessible and demand for public provision should decrease. However, the more interesting dynamic is that of *relative preference asymmetry*. Conventional notions of democracy—"one person, one vote"—imply equal policy weight for all voting individuals. In fact, according to my argument, individuals with fewer service demands who have more lopsided preferences over competing services will have more policy influence.

The hypothesis H_4 suggests that if only *group size* but not *relative preference asymmetry* is important, the effect of a unit of BFP coverage should be uniform across municipalities with lesser or greater BFP coverage. However, if *relative preference asymmetry* is also important then the effect of a unit of BFP coverage on primary care allocation should be heterogeneous. In particular, the effect of a unit of BFP coverage should be larger in municipalities with higher BFP coverage. This is because BFP assignment not only perturbs the preference ordering of recipients over health services, it also makes the BFP-receiving group's preference ordering relatively more influential than that of poor non-recipients because the recipient group develops more lopsided preferences due to decreased demand for primary care.

In the following analysis, the dependent variable is the change in the percentage of the health service budget (totaled over primary and hospital care) that is allocated toward primary care in a municipality from 2004 to 2010. I subdivide municipalities into five roughly equally-sized groups according to BFP target coverage and conduct analyses of the effect of BFP coverage on within-class changes in the health service allocation over the six years

following the start of introduction of the BFP.

In Figures 4.6 and 4.7 I present two hypothetical scenarios. The first, Figure 4.6, represents a situation in which only group size matters. Since the effect of a unit of BFP coverage should be the same for municipalities with either a high or low level of coverage, the effect is anticipated to be approximately constant across subgroups. Figure 4.7 represents a situation in which relative preference asymmetry also matters. That is, the group of poor voters who do not receive BFP, who prefer primary care expenditures, decrease in size; at the same time, the weight on their policy preferences decreases as the recipient poor become comparatively more responsive to health spending shifts, thus compounding the two effects. Figure 4.7, therefore, illustrates a situation in which H_4 is correct—the effect of a unit of BFP coverage gets larger for municipalities with higher coverage levels. Finally, Figure 4.8 shows the actual estimates for the five groups. The size of the (negative) effect of BFP coverage on primary care allocation seems to increase for municipalities with higher program coverage, providing support for hypothesis H_4. The numerical results of this analysis are summarized in Table 4.15.

Figure 4.6: Hypothetical: Only Group Size Matters

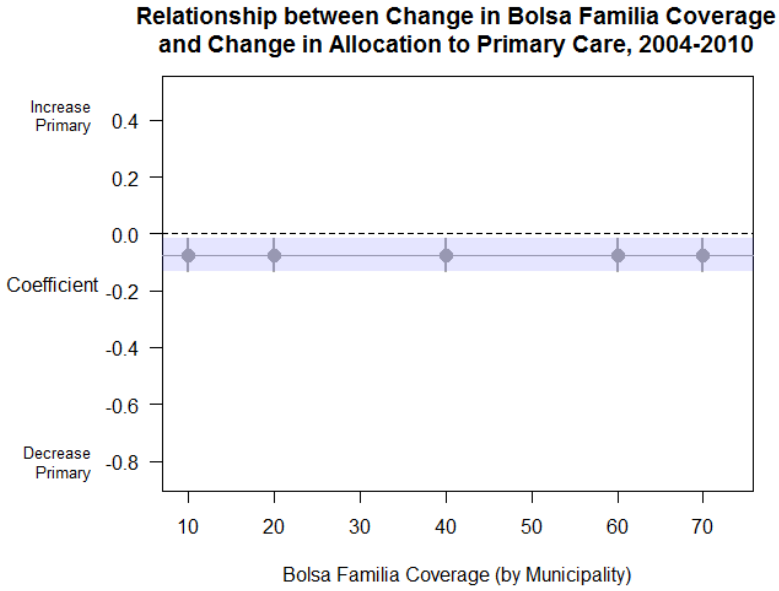


Figure 4.7: Hypothetical: Group Size and Relative Preference Asymmetry Matter

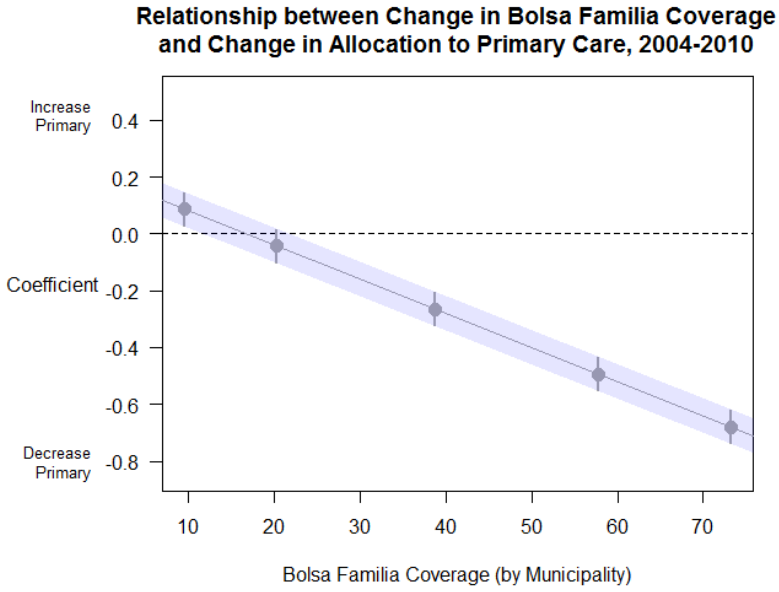


Figure 4.8: Observed Pattern

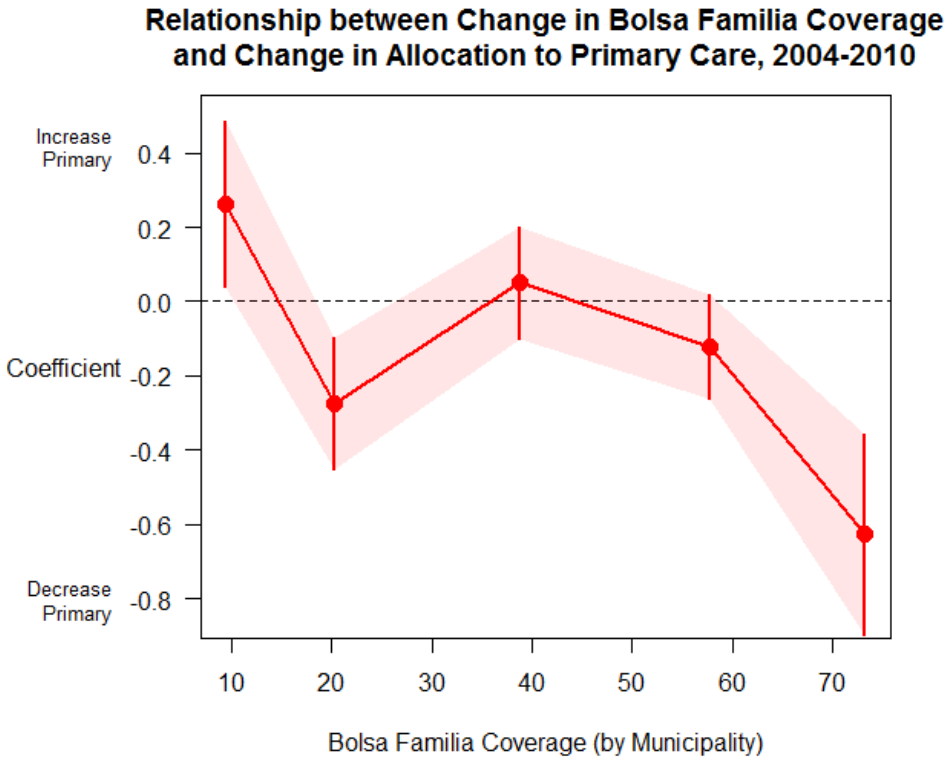


Table 4.15: OLS: Dependent Variable—Share of Spending Allocated to Primary Care

Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
	(Std Err)	(Std Err)	(Std Err)	(Std Err)	(Std Err)
BFP Coverage	0.262*	-0.275***	0.050	-0.120	-0.626***
	(0.134)	(0.109)	(0.092)	(0.085)	(0.164)
Pop (Log)	-2.377***	-1.143*	-2.998***	-6.032***	-10.272***
	(0.663)	(0.674)	(0.754)	(0.914)	(2.330)
Target Coverage (Sq Rt)	-2.920***	-1.259	1.340	-3.718	12.549*
	(1.221)	(1.913)	(1.792)	(3.075)	(7.303)
Presence of Hospital	-3.098***	-0.045	-2.202	-1.026	-3.781
	(1.281)	(1.323)	(1.466)	(1.514)	(3.548)
Percent Rural	-0.048*	0.036	0.033	0.077**	0.086
	(0.029)	(0.028)	(0.030)	(0.038)	(0.090)
Municipal HDI	-0.007***	0.002**	-0.004***	-0.007***	-0.004
	(0.002)	(0.001)	(0.001)	(0.002)	(0.004)
Pop over 200,000	6.249***	-11.579***	2.051	NA	NA
	(2.583)	(3.758)	(4.573)		
Intercept	48.218***	21.069**	30.660***	101.597***	36.902
	(6.880)	(10.422)	(11.239)	(22.361)	(67.888)
N	1,000	1,000	1,000	1,000	975
R^2	0.028	0.009	0.018	0.022	0.060

***0.01 α-level; **0.05 α-level; *0.1 α-level

4.5 Conclusions

This chapter provides evidence that municipal coverage by the *Bolsa Família* Program in Brazil has been associated with local budgetary spending shifts away from primary care services. I discuss how this finding is consistent with substitution logic in exchange theory; I also discuss how it deviates from some exchange theory and public finance predictions that suggest individual consumption and local government supply of public services should be (downwardly) intransigent to income shocks.

I show that the decreases in public primary care spending associated with BFP coverage actually predict decreases in the number of public primary care clinics available. Therefore, the results cannot be attributed only to efficiency gains in primary care provision. I also provide some evidence that supports the mechanisms I proposed in Chapter 2 that may

underlie these shifts. In particular, I show that the association between the BFP and primary care spending may be heterogeneous—specifically, the size of the relationship seems larger in municipalities with higher BFP coverage. This suggests that the BFP has an influence that is larger-than-proportional to its municipal coverage level. This finding is consistent with my claim that decreased public primary care dependence among BFP recipients is associated not just with a decrease in *group size* for the primary care-preferring group of poor voters, but also with a relative decrease in the weight placed on the preferences of this group. I argue this results from changes in *relative preference asymmetry* induced by the increasingly lopsided public health service preferences of poor BFP recipients.

In the next chapter, I turn to look at some of the actual welfare consequences of this shift. As previously mentioned, the BFP is associated with positive health outcomes for recipients. The next chapter examines the degree to which the spillover effects of the BFP on voting behavior and service spending argued to exist thus far affect poor non-recipients of the program. The chapter examines not only heterogeneity in the health outcomes associated with the BFP for recipients and non-recipients, but also assesses the average effect of the Program on infant mortality, pooling across recipients and non-recipients.

CHAPTER 5

Health Benefits for Whom? *Bolsa Família* and Infant Mortality

Within the first year after the Worker's Party (*Partido dos Trabalhadores*) gained control over the executive office in Brazil in 2003, they implemented the *Bolsa Família* (Family Stipend) Program. The Program gives small amounts of cash directly to poor families provided that their children attend school and that the family complies with routinized preventative health care visits. The transfer of funds was designed to go directly from the federal government to the private account of the female head-of-household in recipient families. The Program has been celebrated internationally as a behavior-modifying, bottom-up development model, which simultaneously improves human capital and long-run development prospects, while helping to alleviate poverty in the short-term.

Yet the predicted human capital benefits—in particular, those related to health—have proven somewhat elusive. Some studies claim to show unequivocal health improvements while others find them to be absent. Studies do not necessarily agree on which outcomes are relevant. Perhaps more importantly, they often do not agree on which social subset is the relevant population for evaluating the Program's health effects. Many studies look exclusively at elicited, retrospective self-reports of recipients. Others rely on aggregate data and ecological inference. While some studies compare recipients to a baseline established by non-recipients, these studies typically focus on one temporal cross-section and inference is based on the assumption that the non-recipient group has not been affected by treatment externalities or spillover effects. If this assumption were incorrect, net positive externalities for the poor non-recipients would lead to attenuation bias in the estimated health effects of the BFP. Alternatively, if existing externalities were to net negative for the non-recipient

poor, these cross-sectional analyses would tend to overestimate the effects of the BFP treatment on the treated (i.e., recipients) while failing to capture the negative externalities on non-recipients.

In this chapter, I argue that when it comes to questions of development, one should not only care about the effect of the treatment on the treated. This is especially true if the treated group does not exhaust the universe of poor citizens, as in the case of the BFP. Any spillover effects ought to be explicitly measured and included in any assessment of the treatment effects of the Program. Applying this logic to the high-profile conditional cash transfer program in Brazil, *Bolsa Família*, this chapter uses individual data to parse the aggregate effects of the Program on both recipients of the Program and poor non-recipients. Previous chapters show that the BFP is associated with decreased spending on and access to public primary care services at the municipal level. In this chapter, I show that while the BFP has lead to improvements in the infant mortality outcomes of poor recipients, the same program seems to have harmful spillover effects on the infant mortality rates of poor families that are not BFP recipients in that it tempers improvements in infant mortality among this population. In the aggregate, the tempering effects appear to dominate. This welfare result is consistent with my findings from the previous chapters.

5.1 Relevant Context

5.1.1 Program Evaluation and Spillover Effects

The commonly relied-upon zero spillover assumption (i.e., the assumption of SUTVA compliance) in the evaluation of the health effects of the BFP invites reasonable pause.[1] After all, several papers have shown potential spillover effects of *Bolsa Família* on various non-health outcomes such as crime (Chioda, De Mello and Soares, 2012) and economic growth and consumption (Angelucci and De Giorgi, 2009; Santos, 2010). These (and any other)

[1]The stable unit treatment value assumption, or SUTVA, is meant to simplify individual-level inference about treatment effects. It asserts that the treatment is the same for all treated individuals and that the treatment does not alter the observed outcomes of individuals who do not receive the treatment—i.e., that there are no positive or negative spillover effects of treatment on the untreated.

non-excludable goods affected by the Program will also impact the non-recipient poor, not just the group directly treated by the Program. This logic extends to non-excludable health goods, if their provision is influenced by the Program. In Chapter 4, I show that the BFP is, indeed, associated with decreased spending on and access to public primary care services.

The question of policy spillovers, or externalities for non-recipients, is likely to be extremely relevant in the way *Bolsa Família* affects infant mortality rates for several reasons. Though the BFP is rivalrous and excludable, it is necessarily noisily assigned (Soares, Ribas and Soares, 2010). At current coverage rates, it excludes a considerable volume of eligible poor families as well as many poor ineligible families. The program's targeting is considered very good in that the number of families receiving program coverage that fall outside of the lowest two quintiles of income is very low (Lindert et al., 2007). However, it is also true that as a logical baseline, at least 37.5% of the poorest two quintiles of society are not covered, since presently, 25% of the total Brazilian population is included in the Program. In fact, due to the tendency toward income volatility among the poor and the fact that the BFP updates its income records only every two years for each family, an estimated 44% of the eligible poor were not covered even after the 2006 expansion of the Program (Soares, Ribas and Soares, 2010). This is important, since any resulting changes in the quality or amplitude of non-excludable public services, such as public primary health care services, would be shared with non-recipients.

In Chapter 3, I demonstrated that the BFP has the effect of shifting recipient preferences over the provision of health services. Such a shift is somewhat intuitive. The transfers are often used to consume health goods previously provided to this group through public primary care. More money in-pocket to purchase medications or improve anthropometric outcomes through improved food security are among the positive but excludable benefits that accrue to *Bolsa Família* beneficiaries as a result of the Program.[2] Since the transfer benefits are excludable substitutes for non-excludable public primary care services, the program leads to

[2]A report by IBASE indicates that 87% of BFP recipients report spending at least part of the transfer on food, which should greatly affect nutritional health; 22% of recipients report spending at least part of the transfer money on purchasing medications; 2% report spending it on other medical treatment (Menezes et al., 2008).

decreases in non-excludable services. In Chapter 4, I further show that *Bolsa Família* is, indeed, associated with decreases in the provision of primary care services. This consequence is likely to spill over onto poor non-recipient families.

In addition to the mechanisms I have documented in the previous chapters for health service spillover effects of the BFP, other unintended externalities are also are also plausible. It, therefore, remains unclear what the net effect of the Program should be for the welfare of non-recipients. The Program is likely to increase the institutional access of recipients by creating an institutional link between them and the local Social Assistance bureaucracy. One important source of institutional advantage that comes with BFP assignment is that many other social programs specifically target BFP recipients. These targeted programs range from preferential assignment to other social programs such as *Minha Casa, Minha Vida* (federally-provided housing for poor families) and *PRONATEC* (federally-funded vocational training for the poor), school meetings coordinated between beneficiary families and local political officials, and even the simple increase in preventative health care visits, where resultant referrals to hospitals outside the municipality require interaction with the local Secretary of Health.

This implies there exist at least some negative externalities incurred from non-recipient status in the BFP. Since *Bolsa Família* assignment also serves as the unofficial shortcut assignment mechanism for many other anti-poverty programs, the assignment errors (even if effectively random for the BFP) are then correlated across programs. This means those eligible non-recipients (as well as poor but ineligible non-recipients) will be systematically disadvantaged with respect to the benefits of many social assistance programs. This, in turn, has implications for the health of these non-beneficiaries.

5.1.2 Difficulties in Studying the Health Spillovers from *Bolsa Família*

In order to capture the total effects of the BFP on the health of the poor, one would need to consider both the direct effects on the explicitly treated and any spillover effects on the non-recipient poor. Ideally, one would like to be able to distinguish between these two types

of effects. Existing literature examining the health impacts of the BFP in Brazil is unable to do this. Often researchers rely (explicitly or implicitly) on the SUTVA assumption to ease the high demands of research design in a context where individual-level data with temporal variation is difficult to come by.

Generally, ambiguity in inference regarding the effects of the BFP on health outcomes in Brazil is produced by three factors. First, the BFP operates through more than one mechanism (income shock, a shift toward preventative care modalities, institutional connections, and preferential assignment to other programs), so different outcome variables may pick up different local effects. Conflating the range of health perceptions, behavior and outcome variables as substitutable proxies for health complicates inference. Meta-studies that review the health effects of conditional cash transfer programs across contexts may tend toward ambiguous findings due to the fact that they aggregate studies over dependent variables like clinic visits, food security and anthropometric measures, and perceived health outcomes like self-reports of illness frequency (Lagarde, Haines and Palmer, 2009; Shei et al., 2014). The most consistent health results with respect to the BFP seem to be improvements in the food security perception of recipients (Menezes et al., 2008; Brandão et al., 2007; de Bem Lignani et al., 2011). Results from health outcome measures have often proven less tidy across studies.

Though the retrospective before and after studies of recipients' perceptions on food security are consistent across studies, they are symptomatic of a second pathology with respect to development studies inferences. The choice to restrict analysis to the temporal effects of the Program on only the subset of the poor that are beneficiaries is a valid measurement strategy—albeit, one that is subject to limited generalizability. Interpretation of these results as representative of the overall social impacts of the Program is equivalent to ignoring any externalities and taking the treatment effect on the treated as the whole health story. The effects of the treatment on the treated—or, arguably, the posterior self-perception of treatment effects by the treated—is an interesting quantity in and of itself. However, from a development perspective, it is not sufficient to answer the question "how does the *Bolsa Família* Program impact the overall welfare of the poor?" since "program recipients" and

"the poor" are overlapping, but not completely intersecting population subsets.

Finally, studies that include both beneficiaries and non-beneficiaries of the BFP are typically cross-sectional and conditioned on a single point in time. These include studies of anthropometric measures[3] (Paes-Sousa, Santos and Miazaki, 2011), frequency of preventative health visits (Shei et al., 2014), and infant mortality rates (Rasella et al., 2013). Non-recipients are taken as a baseline, which is equivalent to assuming there are no externalities of the program for the non-recipient poor. Resulting inferences regarding treatment effects on the recipient population based on observed group differences combine treatment effects experienced by both beneficiaries and non-beneficiaries, with the entire difference between groups, and only this difference, being attributed to recipients alone.

5.1.3 CCTs and Health in Latin America and the World

Meta-studies of health effects of conditional cash transfer programs across Latin America have led to ambiguous conclusions, probably largely due to the conflation of several different health-related dependent variables and the sole focus of the studies on recipients. For example, one review shows moderate evidence of beneficiary improvements in the frequency of preventative health care visits and nutrition and anthropometric measures (i.e., those indicators that follow from conditioning transfers on preventative health care visits).[4] With respect to more general health outcomes including child mortality, diarrheal illnesses and respiratory infections, results were less consistent or absent, with Mexico and Colombia's programs producing somewhat clearer results than the other cases (Lagarde, Haines and Palmer, 2009). Similarly, a study of the health effects of conditional cash transfer programs spanning countries in Latin America, Africa, Asia and the Middle East finds some evidence of increased use of preventative health visits associated with conditional cash transfer programs, but generally finds "mixed" results with respect to overall health outcomes.

One potentially fruitful approach to assessing the overall health impacts of conditional

[3]Anthropometric measures are physiological markers such as height and weight, which are often taken as measurements of overall health.

[4]The BFP is not included in this analysis, but an earlier Brazilian CCT, *Bolsa Alimenta cão*, is included. Most of the 10 studies are on Mexico, though Colombia, Nicaragua and Honduras are included as well.

cash transfers on the poor (pooling over recipients and non-recipients) is to use a catch-all measure of health outcomes. For example, Diaz-Cayeros, Estévez and Magaloni examine Mexico's conditional cash transfer program's effect on infant mortality rates (Díaz-Cayeros, Estévez and Magaloni, 2012). This study finds overall improvements in infant mortality rates geographically associated with cash transfer assignment. However the study is limited to looking at changes in infant mortality rates between two Census years (1990 and 2000), which makes the causal link fuzzy, given that the program of interest was first implemented in 1997. Their model also neglects to account for changes in the economic situation of the geographic units over this time.

Barham gets the closest to distinguishing between the general health impacts of conditional cash transfer programs on the recipient and non-recipient poor. She looks at the case of infant mortality in Mexico, as well, explicitly differentiating between the program's association with the population infant mortality rate and the program's association with the average infant mortality rates for the rural, beneficiary poor (Barham, 2011). She finds that though the program is highly associated with improved (decreased) infant mortality rates for the rural poor, the program has no association with overall mortality rates, which implies some heterogeneity of effects of the program. Similarly, this chapter assesses heterogeneity in the impacts of Brazil's BFP on the health of the poor. It attempts to explicitly parse out one form of heterogeneous treatment effect which may be at the root of many of the confusing findings on conditional cash transfers and health. It supplements aggregate-level analyses with individual-level data. It is thus able to distinguish empirically between those overall health effects which pertain to recipients and those that pertain to the non-recipient poor.

5.2 Methodological Approach

5.2.1 Operationalization of the Dependent Variable

In order to assess the health and human capital impacts of the BFP, it is important to choose a broad measure of health that is sensitive to the most serious health threats to the poor—and, ideally, one with clear links to the Program's requirements. While vaccination requirements are explicitly included in the BFP, Brazil already had very high rates of vaccination coverage even before the start of the BFP. As such, changes in vaccination rates in recent years are very small and cannot relay much information on recent changes in health outcomes. There are also measurement issues related to vaccination reports since many children get innoculated multiple times against the same illness as the result of recurring vaccination campaigns. Each vaccination gets counted independently making it difficult to interpret innoculation coverage in percentage terms.

Fortunately, the BFP also requires preventative health visits for children and pre- and post-natal visits for pregnant women, so the Program also ought to be linked closely to overall infant mortality rates. Infant mortality rates serve as a strong barometer of the overall welfare of the poor (Ross, 2006). In terms of measurement, infant mortality rates are general enough to aggregate any and all grave health issues faced by the poor. This includes fatal cases of the most common diseases affecting poor children, including diarrheal and respiratory infections and waterborne illnesses (the last of which still accounts for almost a quarter of preventable illnesses in Brazil).[5] Infant mortality is observable, documented, and constitutes an event unlikely to be vulnerable to recall-issues with respect to self-reports. Furthermore, the fact that others have used this measure to investigate the health impacts of conditional cash transfer programs in various contexts means that carefully studying the measure in light of these previous analyses can contribute to an accumulation of knowledge including the identification of new interpretations of the current body of findings.

[5]See http://data.unicef.org/resources/pneumonia-and-diarrhoea-tackling-the-deadliest-diseases-for-the-world-s-poorest-children and http://www.worldpolicy.org/blog/health-care-brazil-300-year.

5.2.2 Empirical Identification Strategies

I employ four rigorous empirical identification strategies in this research. First, I assess the impact of the BFP on overall health outcomes (including both recipient and non-recipient outcomes), using three approaches. I use a grouped logit model of infant mortality rates with multivariate control for the lagged infant mortality rate as well as various economic, development and state intervention variables. The observations are aggregate (municipal) infant mortality rates and these are observed annually over the period 2005–2010. This method is the closest to those models used in previous published studies and so its usage is important for comparison purposes. Second, I compute a differenced OLS model for the change in infant mortality rates, conditional on the previous year's level and controls. Third, I repeat the differenced model, first subclassifying the data on the official BFP target rates used in assignment before computing the total average treatment effect.

The aggregate-level results may be vulnerable to any of a number of barriers to inference. The last method therefore uses individual-level data with cross-sections observed for two time periods to attempt to deal with problems of ecological inference, to assuage concerns of selection effects, and to identify differing (heterogeneous) recipient and non-recipient treatment effects. It consists of the analysis of the probability of infant mortality, given live birth, of infants born to poor households for each of the two groups of interest. These analyses are based on data from a large household survey, the *Pesquisa Nacional de Amostra dos Domicílios* from 2004, and on Census data from 2010, both of which were administered by the *Instituto Brasileiro de Geografia e Estatística* and which identify the BFP status of respondents.

These methods address the three concerns I highlighted above with respect to the literature in the following ways. I deal with the multiple-mechanism phenomenon by focusing on a very general health outcome measure, rather than perceptions of health or frequency of doctor's visits or some combination. I avoid the problem of limiting inference to only the treatment effect on the treated by including both beneficiaries and non-beneficiaries in all of the analyses. First I average over the two, presenting the total treatment effects. Then I

use individual data to decompose the total effect into the respective contributions of each of the groups of interest. I describe each of these methods in more detail below.

5.2.2.1 Lagged Grouped Logit Analysis of Municipal Data, Pooling over Time

The multivariate grouped logit design models the probability a certain number of infants die in a municipality in a given year, conditional on the number of live births observed that year in that municipality. The model pools over annual data from the 2005–2010 period. Grouped logit models are convenient for estimating proportions where both the numerator and denominator, and not just their ratio, are known. This is ideal since a very high observed ratio may either result from a high probability event with many trials, or from computing the observed ratio based on a very small number of trials (as may occur in many small municipalities). Grouped logit helps to make appropriate use of the variability in binomial sample (trial) sizes across units. Infants born in municipalities with a small number of births may have a different likelihood of dying than those born in large municipalities and the grouped logit helps account for this. In this model I also estimate a dispersion parameter for the quasibinomial distribution to allow for additional flexibility surrounding the assumption of independent Bernoulli trials with respect to infant deaths within a municipality.[6]

Though the proportion of households assigned to the BFP is likely correlated with development, which itself is a predictor of infant mortality, I rely on multivariate control to try to tease out the relationship of interest. I include as control variables the municipal GDP per capita, the Human Development Index score of the municipality for education,[7] the per capita size of federal government transfers to the municipal government, the population size, the percentage of that population that lives in rural conditions, the percentage of the population that is covered by the Family Health Program (a model of primary health care introduced in the 1990s that combines primary care with community health surveillance),

[6]Since the dispersion factor was always greater than 1, I did not estimate an extended-beta binomial since the true dispersion parameter was unlikely to be negative.

[7]I include only the education component of the Human Development Index, since including the other components, GPD and health outcomes, would be akin to including two controls for GDP and to moving the left hand variable to the right hand side, respectively.

the lagged infant mortality rate from the previous year, and the independent variable of interest, the percentage of families in the municipality that receive *Bolsa Família* transfers.[8]

5.2.2.2 Differenced OLS Analysis of Municipal Data, Pooling over Time

This model includes the same control variables as the specification described above, however, it models the dependent variable as the difference in the infant mortality rate since the previous year. Infant mortality is a temporally slow-moving variable and its level is likely correlated with unobserved variables that mutually influence municipal BFP coverage. Looking only at the changes in infant mortality rates helps to ensure that the model only explains post-treatment (BFP assignment) variation in mortality. As the binomial specification is no longer appropriate for this model, I use Ordinary Least Squares estimation. I still include the lagged infant mortality rate, as it seems likely that the rate of change in infant mortality rates is conditioned to some degree upon the previous year's level.

5.2.2.3 Subclassified Differenced Model on Official *Bolsa Família* Target Rates

As concerns over the plausibility of the exogeneity of BFP assignment are still reasonable, I use an additional method to attempt to parse out an average causal effect. The BFP is assigned at the federal level based on household income reported during a family assessment interview and verified by official employment records. The number of stipends awarded in each municipality is a function of official target rates generated formulaically from aggregate income estimates and geographic development goals. Due to the frequency of income volatility among the poor as well as informal sector employment that is impossible to verify, the income assignment mechanism is necessarily noisy (Soares, Ribas and Soares, 2010). As the target rates represent the official assignment goals of the Program and observed variation in assignment from these target rates is generated by noise, I use subclassification on the official target rates to try to isolate the exogenous component of assignment, similar to the

[8]The infant mortality data was gathered from the Pan-American Health Organization and is originally from the Ministry of Health in Brazil. The other variables come from the databases of IPEA, the *Instituto de Pesquisa Econômica Aplicada*, IBGE, the *Instituto Brasileiro de Geografia e Economia*, the National Treasury of Brazil, and DATASUS, the database of the public health system.

method proposed in Imai and Van Dyk (Imai and Van Dyk, 2004). Others have used a similar approach to try to estimate the causal effect of *Bolsa Família* assignment on voting behavior with respect to incumbent candidates (Zucco, 2013). I subclassify municipalities into 10 subgroups of roughly equal sample size based on their targeting rates. I then repeat the differenced analysis described above, including all the control variables, for each of the 10 groups separately, so that the BFP variable only captures observed municipal treatment variation between municipalities with like target rates. Finally I compute the weighted average of these 10 estimates to get the estimate of the total treatment effect.

5.2.2.4 Parsing the Effects on the Poor with Time-Varying, Individual Data

The aggregate-level analyses cannot say much about how the BFP affects different segments of the population. This final analysis uses household survey data from 2004 and 2010 to estimate individual-level effects of recipient status on the health of the poor. One benefit of using self-reports for measuring income mortality is that it may be subject to fewer sources of measurement error than official hospital data. Not all babies are born or die in hospitals. Furthermore, the rates of births and deaths occuring in hospitals, rather than at home, may vary over time. Infant mortality rates also often aggregate multiple sources of information, making it possible to double-count single instances. However, the delivering mother has complete information and high recall on the birth and (with very few exceptions in the data) the death of any infants within the last year. The obvious tradeoff is that self-reports may be subject to under-reporting due to social desirability bias. However, this effect is unlikely to change much over the short time period examined in this analysis, meaning it should only affect intercept estimates for the average probability of infant mortality, but not within-group changes in mortality rates over time.

I estimate the cutoff for the poorest two household income quintiles using the household survey data on within-household per capita income. I then classify all sampled individuals falling below this cutoff who do not receive BFP stipends as the "non-recipient the poor." "Recipients" are those that self-identify as participants in the the *Bolsa Família* Program.

From these two subsets I identify all individuals who report having given birth in the year before the reference date. These births are taken as the sample of infants used for estimation. I use a linear probability model (i.e., I compute the average number of deaths among these infants) for the two groups in 2004 and 2010 to construct a difference-in-differences estimator.[9]

This methodology, though an improvement on those methods used to address this question in the past, is still subject to two limitations. The first is that, despite the availability of temporal variation for the two groups, the data are not panel data and the recipient status label is not necessarily static over time. The second is that it assumes (as do all infant mortality analyses, regardless of whether individual or aggregate) that the groups being compared do not differ greatly in the shape of the distribution of the time of year their children are born or the age of the mother, etc. There is some support for the assumption that the two groups are as-though randomly assigned among the poor with respect to infant mortality rates. In 2004 (the first year of the program's existence after it was created in October of 2003), the average infant mortality rates of the two groups do not differ significantly, as shown in Figure 3.[10]

5.3 Results

5.3.1 Grouped Logit Results

Table 5.1 below shows the results of the grouped logit analysis. The coefficient of interest on BFP coverage in a municipality (conditional on municipal income, last year's infant mor-

[9]Figure 3 shows that in 2004 recipients and the non-recipient poor had effectively the same probability of infant death in 2004 when estimated independently, so I model a single intercept in 2004, but separate intercepts for the two groups in 2010.

[10]Note that though *Bolsa Família* was initiated by President Lula in late 2003, a few municipalities had already implemented local versions of conditional cash transfer programs emphasizing educational conditionalities in the late 90s and President Cardoso had implemented a series of smaller national conditional cash transfer programs in 2001, including one with health requirements. The unified assignment mechanism of the BFP however, the *Cadastro Único*, was conceived as part of the consolidation and expansion of these programs in 2004 under Lula under the rubric *Bolsa Família* (Lindert et al., 2007). It is this assignment mechanism that subsequently became standardized across many social programs beyond the BFP, leading to correlated program assignment.

tality rate, and the HDI education score, among the other control variables) is positive and highly statistically significant. That is, conditional on the control variables and pooling over time, the BFP seems associated with relatively worse infant mortality outcomes.[11]

Table 5.1: Grouped Logit: Dependent Variable—Infant Deaths | Live Births

Variable	**Coefficient** (Std Err)
Bolsa Família Coverage (Sq Rt)	0.028***
	(0.003)
HDI Education Score	-0.579***
	(0.036)
Federal to Municipal Transfers (Log)	0.013
	(0.009)
Municipal GDP per cap (Log)	-0.039***
	(0.007)
Population (Log)	0.024***
	(0.003)
Percent Pop Living in Rural Conditions	-0.001***
	(0.000)
Family Health Program Coverage	-0.0002*
	(0.000)
Lagged Infant Mortality Rate (Log)	0.334***
	(0.007)
Intercept	-4.783***
	(0.087)
N	29,742
Quasibinomial Dispersion Parameter	2.41

***0.01 α-level; **0.05 α-level; *0.1 α-level

Not surprisingly, last year's municipal infant mortality rate is a strong predictor of this year's. Other predictable control results are that the probability an infant dies during its first year of life is a decreasing function of the municipality's education score, income, and coverage of families by the Family Health Program. Infant mortality appears to be positively associated with the size of the municipality's population, which is a plausible result given that infectious illness spreads more rapidly in densely populated regions. However, infant

[11]Though the results are not included here, the bivariate grouped logit results where only BFP coverage is included on the right-hand side also produces a positive and highly significant coefficient, as does the grouped logit model of infant mortality with only BFP coverage and lagged infant mortality on the right-hand side.

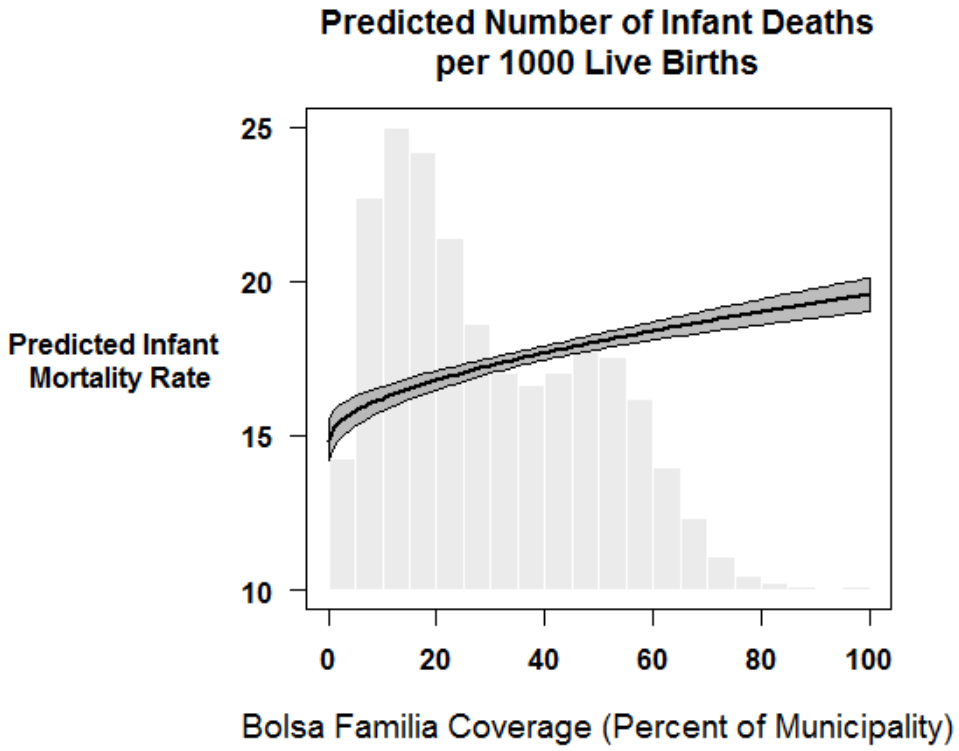
deaths also seem to be negatively associated with rural living conditions, though the size of the effect is miniscule. Despite the fact that infectious diseases spread fastest in cities, this result is somewhat surprising since hospitals tend to be much less accessible to rural communities. However, the absence of hospitals may mean an increased likelihood of child delivery outside of the context of official medical care, and thus, underreporting of deaths may be more prevalent. The size of per capita transfers from the federal government to the local government, after accounting for the BFP and the Family Health Program does not produce a statistically significant result.

Figure 5.1 plots predicted municipal infant mortality rates (per 1,000 live births) over the range of all possible municipal coverage rates of the BFP, with a 95% confidence interval. The histogram of the actual distribution of *Bolsa Família* coverage across municipalities in the data is provided for more realistic interpretation of the range of plausible results. The predictions were computed holding all variables at their mean values, except municipal GDP, which is held at its 25th percentile value. For a municipality with these covariate values, an increase from no BFP coverage in one year to 15% BFP coverage (close to the modal coverage rate of 14.6% in the time period covered by the data) in the next year is associated with an average of about 1.7 additional infant deaths per 1,000 live births (an increase from 14.8 to 16.5).

My finding thus contrasts with that of Rasella et at., who find that the BFP is negatively associated with child mortality rates across municipalities (i.e., that the Program decreases the likelihood of deaths of children under five) (Rasella et al., 2013). One possible reason for the difference is that Rasella, et al.'s modeling strategy resulted in the elimination of nearly half of the municipalities from the dataset they used.[12] Admirably, they execute their analysis for various different dependent variables, looking not just at childhood mortality rates, but also assessing mortality from various specific causes. To maintain a consistent sample of cases across the different dependent variable analyses, they remove from their sample any municipality with missingness on any one of these dependent variables during

[12]It is not possible to say with certainty whether selection on the dependent variable explains the difference in the results of the two studies because the authors were unable to provide the data for the purposes of replication due to an ongoing project.

Figure 5.1: Predicted Municipal Infant Mortality Rate

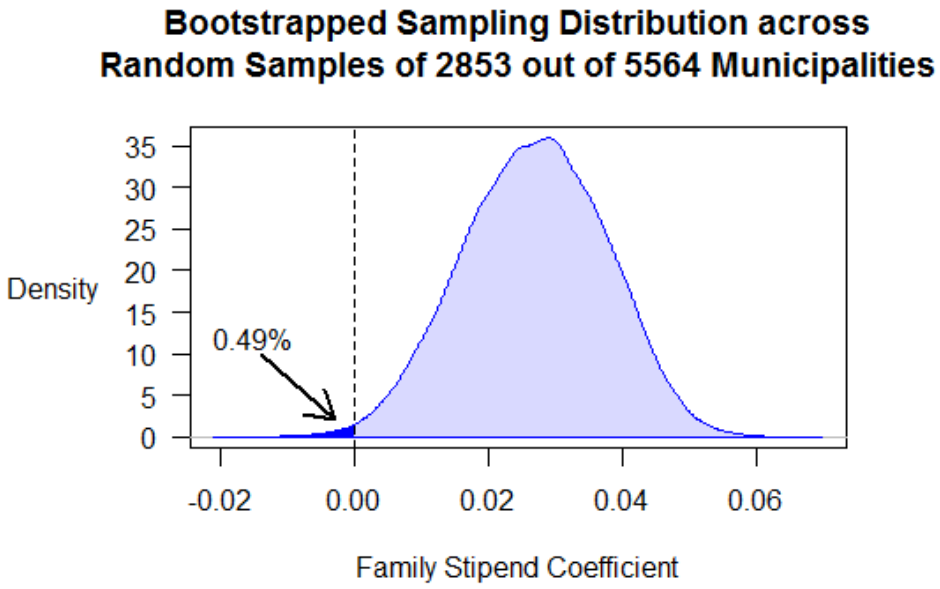


the years 2004-2006 (the first three years in their dataset). As a result, they execute their analysis on 2,853 of the 5,564 municipalities in Brazil, or 51% of the cases. By contrast, Table 5.1 presents results from an analysis executed on a sample that includes over 90% of the universe of municipalities.

It is unlikely that the cases with imperfect health documentation are randomly distributed. In fact, research has shown that municipalities in the poorest parts of the country, especially in the north and northeastern regions, are most likely to have imperfect health data (Szwarcwald et al., 2002). I engage in a bootstrapping exercise to approximate the frequency with which one would obtain a negative coefficient (as in the Rasella, et al. analysis) using the model I have presented in Table 5.1 when the analysis is executed on a similarly reduced sub-sample of municipalities. Figure 5.2 provides the sampling distribution of coefficients on the BFP resulting from 100,000 iterations of analyses with different random samples of combinations of 2,853 municipalities chosen from among the 5,564. Less than one-half of

one percent of iterations (0.49%) of randomly-selected subsets of this size produce a negative result using this model.[13]

Figure 5.2: Simulated Coefficient Variability: Lagged Model



5.3.2 OLS Results for Change in Infant Mortality

Arguably, the ideal measurement of the dependent variable is the change in infant mortality rate associated with *Bolsa Família* treatment assignment, and not the level. One benefit of this model specification is that it models only post-treatment movement on the dependent variable, while allowing this movement to be conditioned upon pre-treatment levels. Furthermore, in the presence of the lagged measure of infant mortality rate, this method removes a considerable amount of multicollinearity from the model. The results presented

[13]Rasella, et al. use a somewhat different model specification. The most important difference is that they use municipality fixed-effects rather than the lagged infant mortality rate. Since maximum likelihood estimation of generalized linear models with geographic fixed effects is known to be inconsistent when executed on panel data with many cross-sectional cases but with few years (Nerlove, 1971), I do not take this approach. However, linearly controlling for the mean municipal infant mortality rate across years in the sample does not alter my results significantly. The statistical and substantive interpretation of the results in Table 5.1 are also robust to an alternative negative binomial specification with the dependent variable being the mortality rate, which is the method preferred by Rasella, et al. I do not use this model for my core specification because it does not adequately treat the varying number of "trials" (births) across municipalities of different sizes and so is most appropriate for count data with a fixed trial size, rather than ratios.

in Table 5.2 are from an OLS estimation procedure that uses the same independent and control variables as the model presented in Table 5.1, including the measure of last year's level, but substitutes the difference in infant mortality rate from the last year to this as the dependent variable. The results are comparable to those from the model presented in Table 5.1 in direction, magnitude and significance, despite the shift in model specification. This model also shows a positive association between the BFP and increases in infant mortality (or at least fewer decreases) relative to municipalities with fewer BFP recipients.

Table 5.2: OLS: Dependent Variable—Change in Infant Mortality Rate

Variable	**Coefficient** (Std Err)
Bolsa Família Coverage (Sq Rt)	0.913*** (0.242)
HDI Education Score	-21.867*** (2.714)
Federal to Municipal Transfers (Log)	-10.169*** (0.923)
Municipal GDP per cap (Log)	-0.925* (0.545)
Population (Log)	0.940** (0.389)
Percent Pop Living in Rural Conditions	-0.031** (0.014)
Family Health Program Coverage	-0.005 (0.008)
Lagged Infant Mortality Rate (Log)	-13.551*** (0.209)
Intercept	105.285*** (9.197)
N	29,742
Adjusted R^2	0.124

***0.01 α-level; **0.05 α-level; *0.1 α-level

5.3.3 Subclassification on Target Rates Results

Subclassifying the data on official BFP target rates for municipalities before executing the differenced model decreases the power of the BFP result in terms of statistical signficance,

though the coefficient is still statistically significant at the 0.1 α level. However, the size of the BFP coefficient does not decrease, indicating a loss of efficiency is responsible for the attenuation of significance, rather than bias-correction. The substantive interpretation of the result with respect to the focal independent variable, therefore, remains the same. In municipalities with similar BFP target rates, higher BFP assignment is still associated with increases (or at least fewer decreases) in infant mortality. These results are reported in Table 5.3 below.

Table 5.3: OLS with Subclassification: Dependent Variable—Change in Infant Mortality Rate

Variable	**Coefficient** (Std Err)
Bolsa Família Coverage (Sq Rt)	0.912*
	(0.478)
HDI Education Score	-12.000***
	(3.436)
Federal to Municipal Transfers (Log)	-6.272***
	(1.441)
Municipal GDP per cap (Log)	0.073
	(0.661)
Population (Log)	2.833***
	(0.492)
Percent Pop Living in Rural Conditions	-0.021
	(0.015)
Family Health Program Coverage	-0.006
	(0.010)
Lagged Infant Mortality Rate (Log)	-12.840***
	(0.194)
Intercept	41.113***
	(14.391)
N	29,742

***0.01 α-level; **0.05 α-level; *0.1 α-level

5.3.4 Difference-in-Differences with Individual Data

The net total of treatment effects on all members of society presented above are still difficult to interpret substantively from a development perspective. Do the total effects reflect the impact of the BFP and its externalities on the poor? Can the effects of the BFP be further

partitioned into hetergeneous effects on recipients and non-recipients among the poor? These questions require individual-level data to support responsible inference. Figure 5.3 below shows the frequency of infant deaths per 100 live births (i.e., the percentage of infants born in the reference year that died prior to the reference date) for recipients and for non-recipients in the poorest two per capita household income quintiles of society in 2004 and 2010 (with non-recipient poor rates for previous years included for context). Far more data are available for the Census year, 2010, than for 2004, which explains the differing sizes of the 90% confidence intervals for the two years. The plot shows that in 2004—the first year after the start of the program in October of 2003—the recipient and non-recipient groups had roughly equal and statistically indifferentiable infant mortality rates. This suggests that the two groups were not very different on dimensions affecting infant mortality when the Program started.[14] The recipient group then experienced considerable improvement by 2010. The non-recipient poor, however, seem to have experienced markedly slower improvements starting just after the BFP was implemented. This suggests the presence of negative spillover effects.

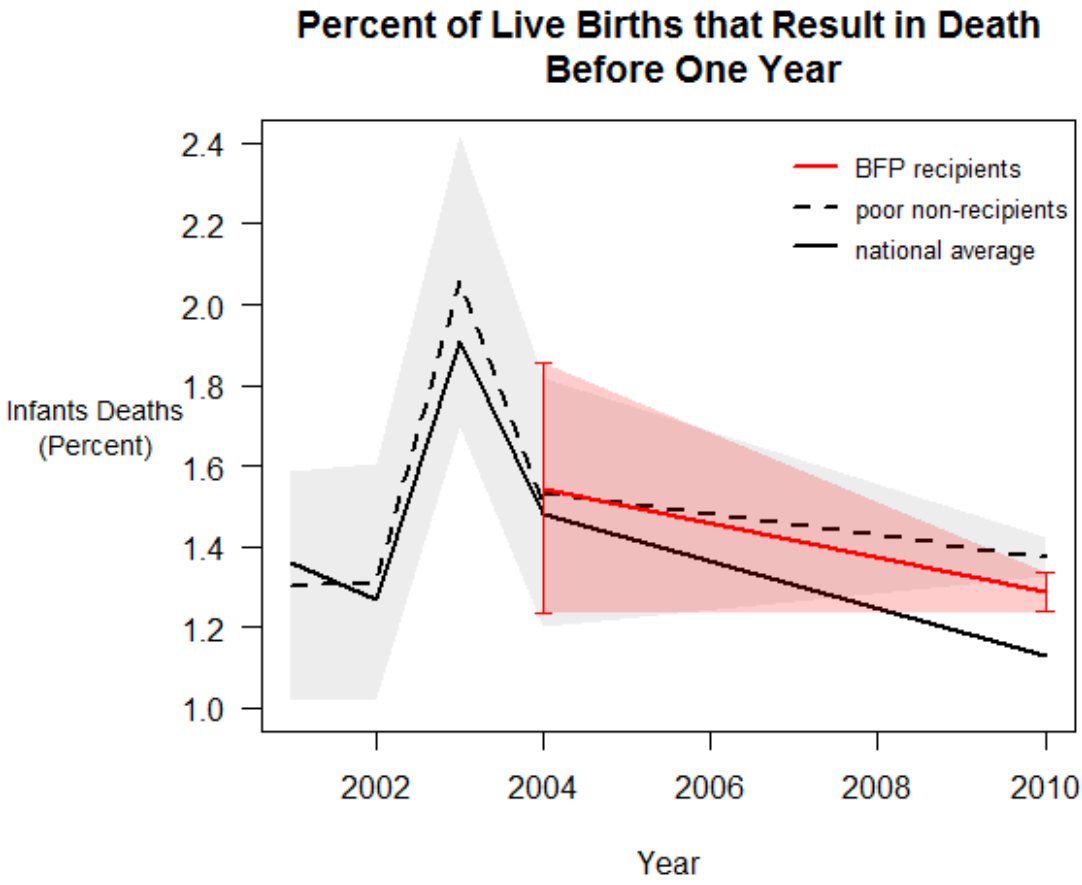
Table 5.4 provides a numerical summary of the difference-in-differences results. It shows that in 2004, according to self reports, over 1.5% of infants born to recipients or to the non-recipient poor died before reaching one year of age.[15] From there, the non-recipient poor experience a non-significant drop down to 1.4%, while the recipients experience a drop down to 1.3% (that is, double the decrease experienced by the non-recipient poor) that falls just short of conventional significance levels. Thus, there is some weak statistical evidence for negative spillover effects and, certainly, the evidence suggests that positive spillover effects do not dominate. While all social groups (including the better-off) experience a slow-down in infant mortality improvements after 2004, recipients are better able to maintain improvements near the rate of the national average, whereas the non-recipient poor drop considerably below the average rate of improvement, despite starting at the same rate as recipients in 2004. Taken in combination with the aggregate results, the implications of

[14]That is, there is no evidence that non-recipient families have not registered for the Program because the parents are less competent, which would also affect infant mortality, or on other such dimensions.

[15]I have constrained the two groups to have the same intercept in 2004 in this model since estimating the intercept separately leads to (not significantly different) estimates of the infant death rate at 1.53% and 1.55% for infants in the non-recipient poor and recipient groups, respectively in 2004.

these results are important, if surprising given the conventional wisdom about the Program's immense development success. These findings may help to account for the mixed results of health assessments of the Program.

Figure 5.3: Probability of Infant Deaths among Recipients and Poor Non-recipients



One might question the validity of the survey instrument, since self-reports can be subject to any of a number of downward social biases, compared to official medical data. Fortunately, it is possible to compare country-wide estimates of infant mortality rates for 2001 - 2010 from the individual data with the official aggregates provided by the Ministry of Health that were used in the municipality-level analyses.[16] Figure 5.4 shows a comparison of the population-weighted aggregate with the estimates I calculate for the whole population from the inverse-sampling-weighted individual-level self-report data (with 95% confidence inter-

[16]Unfortunately, the household survey used to compute these results did not regularly include a question identifying the BFP status of the family.

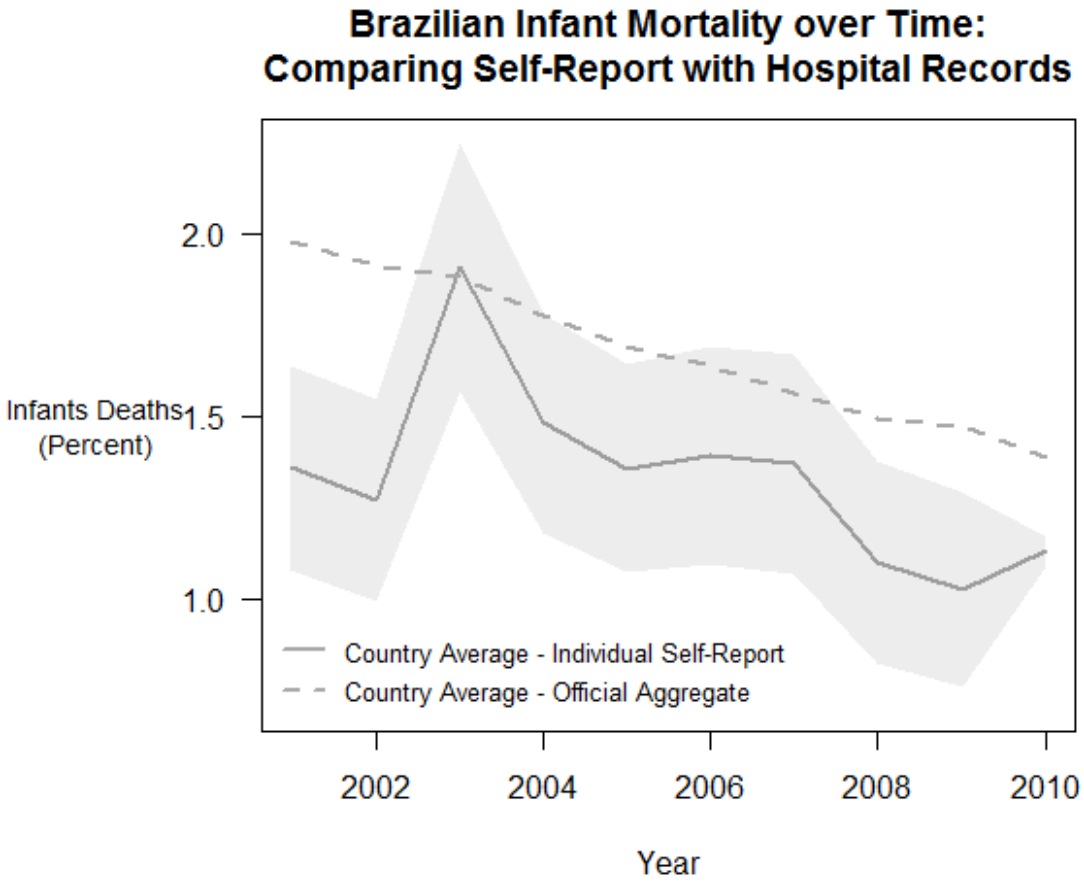
Table 5.4: Linear Difference-in-Differences: Dependent Variable—Linear Probability of Infant Mortality (Percentage)

Variable	**Coefficient** (Std Err)	**p-value**
Expected Percentage Death in 2004 (Intercept)	1.534*** (0.179)	0.000
Non-recipient Decrease by 2010	-0.124 (0.183)	0.497
Additional Recipient Decrease by 2010	-0.090 (0.059)	0.127
N	173,266	

***0.01 α-level; **0.05 α-level; *0.1 α-level; N includes 4,235 and 169,031 observations in 2004 and 2010, respectively.

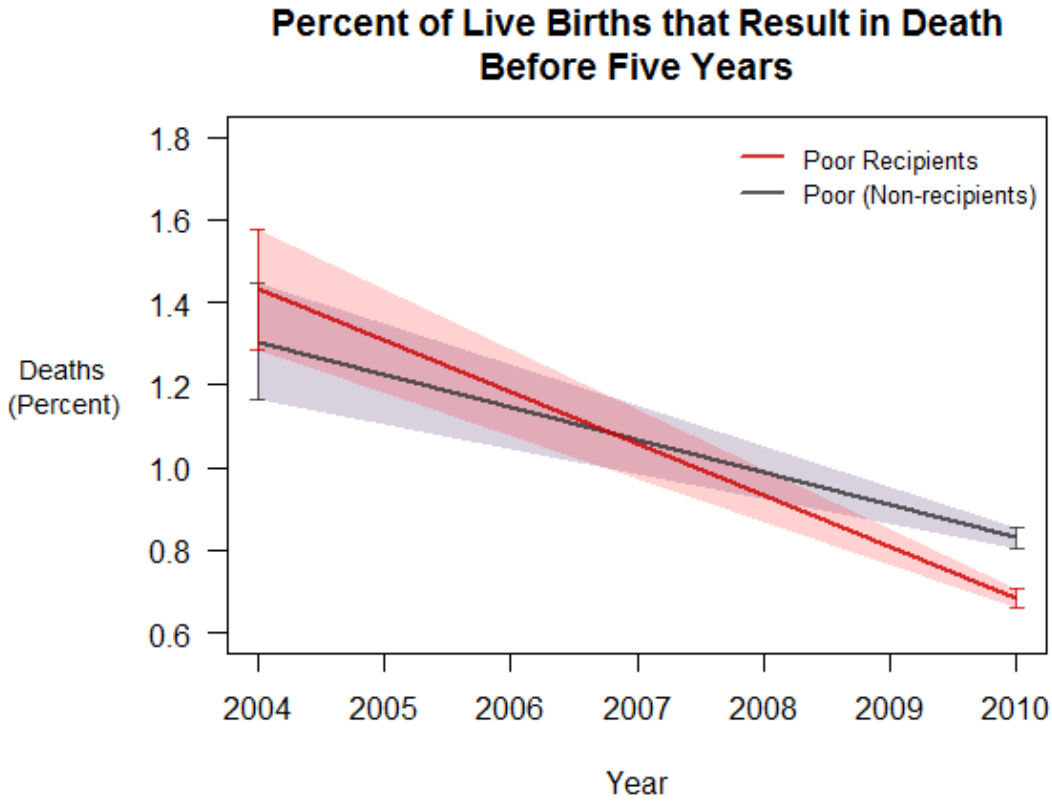
val). The results seem to indicate that downward bias in self-reporting does exist, though at a fairly consistent rate over the 2004-2010 period included in the difference-in-differences analysis. Furthermore, the self-reports may capture year-to-year variability in deaths occurring outside of the official medical context documented by the Ministry of Health. This makes sense as the groups that do not have hospital access are likely to overlap with those whose infant mortality rates are highly sensitive to economic fluctuation as well as variability in the disease burden for any given year.

Figure 5.4: Data Quality



When I repeat the individual difference-in-differences analysis for child mortality among the poor, rather than infant mortality, the sample size increases considerably. The same trend is present—that is, the recipient poor experience considerably larger decreases in infant mortality than the non-recipient poor—and in this case, the result is statistically significant at conventional levels. Figure 5.5 depicts these results.

Figure 5.5: Probability of Child Deaths among Recipients and Poor Non-recipients



5.4 Discussion

The results suggest that the *Bolsa Família* Program has different effects on recipients and the non-recipient poor. The combination of the individual and aggregate data indicate that the Program may actually temper the survival prospects of poor non-recipient infants. Given the necessarily noisy assignment of the BFP, this interpretation is consistent with the aggregate finding that, averaging over all residents including recipients and non-recipients of the Program, the BFP is associated with relatively worse infant mortality outcomes. The individual data analysis also helps to assuage fears that BFP recipients are fundamentally different than non-recipients in terms of pre-BFP infant mortality rates. The individual data suggest that in 2004, toward the start of the BFP, the two groups had statistically similar infant mortality rates, indicating it is unlikely that the result is due to initial selection effects

in program assignment.

These results are consistent with the findings of the previous chapters. In particular, Chapter 3 shows that, with respect to voting behavior, BFP recipients tend to prefer hospital spending to primary care spending. I also show this contrasts with the preferences of the non-recipient poor. Chapter 4 then shows that public health spending follows the shifting preferences of the recipient poor—when more families receive BFP assignment in a municipality, more municipal funding is subsequently shifted away from primary care and toward hospital care. I further show that this shift produces decreased access to non-excludable (public) primary care clinics. This chapter shows that there seem to be welfare consequences to this causal sequence for the non-recipient poor. This group experiences slower rates of improvement in infant mortality and child mortality after the start of the BFP.

These results may change the way we interpret past findings regarding the health implications of development programs like the BFP by adding context to the ambiguous "mixed" health results that studies which marginalize over recipients and non-recipients tend to find. From the standpoint of causal inference, if we look only at the average treatment effect of the Program on the treated (i.e., on recipients), thus ignoring any spillover effects, we may conclude, as many have, that the BFP is associated with improved overall health outcomes.

However, if we return to our objective of evaluating the development impacts of the Program with respect to overall health outcomes, then we ought to take into account spillover effects of the Program onto the non-recipient poor. Once we allow for this possible SUTVA violation and attempt to estimate heterogenous effects of the Program we confront an inevitable reality—it becomes impossible to resolve the overall development question without first specifying some objective welfare function that takes as inputs not just average health outcomes, but also the distribution among them.

5.4.1 Policy Implications

Since not all the poor receive *Bolsa Família* transfers and non-recipient status seems associated with some negative externalities, certain policy implications follow. Perhaps the most

important implication is that the practice of using BFP status as the default preferential assignment mechanism for most other social programs operated under the Ministry of Social Development could potentially exacerbate negative development externalities. Currently BFP recipients receive preferential access or assignment to programs such as *Minha Casa, Minha Vida* (government housing), the *Programa Nacional de Acesso ao Ensino Técnico e Emprego* and *Próximo Passo* (technical training and employment), *Brasil Alfabetizado* (literacy program), *Olhar Brasil* (eyeglasses for Brazil), *Aqui Tem Farmácia Popular* (free distribution of medications), *Rede Cegonha* (specialized treatment for pregnant mothers and infant children), and *Saúde nas Escolas* (health consultations in schools).[17]

This approach takes what may well be random noise in BFP assignment and makes it non-random by correlating treatment status across various development programs. Exclusion from the BFP, even given true eligibility then implies systematic exclusion from many social programs which could contribute to individual health and welfare. Ironically, the *Cadastro Único*, or the Single Unified Registry, which serves as the basis for the assignment mechanism of the BFP, is oft taken as the most developmentally-progressive component of the Program. Santos, et al., capture the optimism regarding the generalization of the use of the Registry beyond BFP assignment when they write, "systems integration looks like the next step for building a better and more egalitarian society" (Santos et al., 2011). In fact, the single assignment mechanism, though logically-consistent and administratively-efficient, may be statistically-flawed and this fact should be included in the evaluation of its institutional implications.

5.5 Conclusion and Further Research

This paper presents evidence that the *Bolsa Família* Program in Brazil seems to have a net harmful effect on infant mortality rates and that the program is associated with both gains for recipients and negative externalities for the non-recipient poor. Several lessons

[17] See also http://www.mds.gov.br/falemds/perguntas-frequentes/superacao-da-extrema-pobreza%20/plano-brasil-sem-miseria-1/plano-brasil-sem-miseria.

may be taken from this research. First, it is important to match the subpopulation under evaluation with the question at hand. When the success of a policy is evaluated from a development perspective, it may well be that the relevant population is not just the group assigned to the policy or the target group, but the whole of the poor population or an even broader subset, depending on the plausibility of the SUTVA assumption and one's definition of "development."

With the recent emphasis in the literature on identifying causal relationships, there has often been a cautious narrowing of the generality of claims of findings. This cautiousness is appropriate; however, there is no reason why the quest to identify causal relationships should be treated as mutually exclusive with the answering of broad practical questions. A failure to identify all the appropriate subpopulations of interest and to parse out the relevant heterogeneous effects attributable to spillover effects may undergird the considerable variability of causal claims regarding the relationship between the BFP and health outcomes.

Second, this paper highlights the fact that logically-consistent policy is not always statistically reasonable policy. For example, the use of a single assignment mechanism to identify the group of poor voters eligible for a wide range of pro-poor policies is logically consistent. However, if the assignment mechanism is noisy (i.e., some people that should be enrolled in these programs are not and others that should not be are), then the errors and spillover effects will be correlated across policies. That is, the single-but-noisy assignment mechanism implies policy externalities will pile-up on the same group of poor voters who are accidentally excluded from recipient-status. What might be the minor consequence of essentially random exclusion from one program becomes a major consequence due to subsequent systematic exclusion from a host of pro-poor programs. Overlooking this fact can have problematic development implications. If we acknowledge noise in assignment to treatment we may be forced to acknowledge that unobserved assignment noise is best left uncorrelated by assignment design—in particular, when the spillover effects of the policy have yet to be identified or have been identified as negative. This implies that, at least in some situations, the efficiency gain of simplifying assignment to one mechanism across programs can have a significant development cost.

The differing welfare results of the BFP on recipients and poor non-recipients provide further support for the theoretical mechanisms proposed in Chapter 2 for the insufficiency of democratic accountability to motivate public service provision that meets the health care demands of the poor. When the BFP decreases the dependence of recipients on publicly-provided (non-excludable) primary care services, it serves to concentrate this groups interests on hospital care. Chapter 2 suggests two mechanisms for decreased access to public primary services for the non-recipient poor. The first is that there exists a decrease in the group size of voters favoring primary care. The second is that the voters that are highly dependent on both public primary care and hospital care will have less influence on policy than voters with fewer demands that are concentrated on only one service. This chapter illustrates the potential welfare consequences of such a shift.

CHAPTER 6

Conclusion

This dissertation addresses a consistent empirical challenge to the predictions of democratic theory: the poor, despite being enfranchised and numerous, often fail to secure public provision of services they demand. Traditional explanations suggest that either the poor do not actually demand such services, or more likely, they find themselves unable to hold elected politicians accountable for service provision. In this dissertation, I propose a new mechanism that could underlie constrained accountability. I show that even when the poor demand services, turn out to vote, and vote their interests, they may still be disadvantaged in service provision in democracy under certain circumstances. In particular, they will be disadvantaged if their service interests are diffuse across various service categories while wealthier individuals have more concentrated service demands. This is most likely when the demands of the poor differ greatly from the demands of the wealthy, which I expect to be most common in highly unequal societies.

In Chapter 2, I presented a mathematical model that demonstrates the logic of my argument. Typical democratic accountability arguments suggest that groups' policy representation should be weighted proportionally to the size of the group, assuming all groups turn out to vote at equal rates and possess the same information. My model confirms this logic, but highlights a mediating factor: group weight in policy representation is also governed by the concentration of service demands for the group, compared to the concentration of other groups' demands. This insight is similar to the logic that single-issue voters will be more impactful in elections than will multi-issue voters. In this dissertation I have elaborated this logic in a formal and general sense. I also add the insight that, with respect to service provision, those with more diffuse interests may tend to be those most dependent on the state

for survival needs (i.e., the poor). In democracies where service demands vary greatly across socioeconomic classes and where elected politicians are more driven by tactical spending than ideological concerns, this phenomenon is likely to be especially important.

Chapters 3 and 4 then attempt to address various implications of the argument in a real setting. I focus on a single decentralized democracy, Brazil, to hold democratic institutions constant. In Chapter 3, I show using original survey data that the poor in Brazil have different revealed service preferences than the better-off. I also show that a conditional cash transfer program (*Bolsa Família*) that decreases the dependence of the recipient poor on public primary care provision serves to shift the preferences of this group toward hospital care and to increase recipients' responsiveness to service spending by concentrating service demands on their preferred service. In addition to applying the logic of my model to an empirical setting and generating predictions regarding service spending dynamics in Brazilian municipalities, the chapter is also relevant to discussions of predictors of voting behavior in Brazilian politics.

In Chapter 4, I provided tests of the implications of my model in light of the findings in Chapter 3. I turn to the macro-implications of the model, showing that *Bolsa Família*, which decreases dependence on public primary care services for recipients, is associated with decreases in public spending on these non-excludable services. The chapter shows that municipal funds follow the shifting preferences of transfer-recipients, toward hospital care. I further show that these spending shifts actually decrease access to public primary care clinics. Finally, I show that the shift seems to be the result not just of a growth in group size for voters that prefer hospital spending, but also results from increased policy influence for the recipient group whose preferences become more concentrated on hospital care than they previously were on primary care.

Finally, Chapter 5 addresses the welfare implications of this research. It shows that there are consequences for the infant and child mortality rates of the non-recipient poor following the loss in access to public primary care clinics shown to be associated with *Bolsa Família*. The chapter also makes several contributions to the program evaluation literature. It highlights the problem of looking only at the effects of the treatment on the treated, when

the ultimate goal is general pro-poor development. It also points to the difficulties that may arise when assignment errors are correlated across multiple development programs.

This research has various implications for the literature on democratic accountability, redistribution and voting behavior. One relevant insight is that a group's policy weight is determined not just by the diffusion of their own service demands, but by the diffusion of the demands of other competing groups. In particular, I show that a group with static preferences (such as the non-recipient poor) can suffer decreases in policy influence simply because a different group (say, the recipient poor or the better-off) experience increased concentration of their competing service demands.

The research presented in this dissertation can also contribute to a new understanding of the mechanism behind democratic redistribution. In particular, it updates Meltzer and Richard's claim that unequal democracies should redistribute more than equal democracies (Meltzer and Richard, 1981). I find that this will not necessarily be the case if the poor in unequal democracies tend to have more diffuse service demands than the better-off. My model makes fewer assumptions about the preferences of the poor than does Meltzer and Richard's (in particular, it assumes the poor value public services, but says nothing about the overall attitude of the poor toward redistribution). At the same time, it elaborates additional implications. My model suggests that the central intuition behind Meltzer and Richard's argument (or at least a stochastic interpretation of it) is sound—larger groups should have a larger influence on policy, all else equal. However, my model also suggests that all other things are often not equal. Another relevant factor is that the preferences of a group that is disproportionately more responsive to one policy than to another will receive greater policy weight from vote-maximizing politicians than groups with more symmetrical preferences, even when the service demands of the latter group are larger.

Another implication of this research is that, in democratic contexts characterized by tactical spending by politicians, inequality may be self-perpetuating (the opposite of the Meltzer and Richard hypothesis). Societies that are unequal early in their democratic history may tend to produce elected politicians who are less sensitive to the service preferences of the poor. This would be consistent with some path-dependency research in the literature on

the political economy of economic growth (Acemoglu, Johnson and Robinson, 2001; Sokoloff and Engerman, 2000; Banerjee and Iyer, 2002). It is worth noting that a significant body of research suggests that programmatic politics can produce economic policy that favors increased equality, suggesting that the persistence of existing inequality need not be inevitable, especially in certain contexts (Iversen and Soskice, 2006; Bartels, 2009).

This research may also make a more general contribution to the distributive politics literature. It is worth noting that while I have designed the model to describe allocation dynamics across competing public services, there is no reason it could not be generalized to other competing policies or competing goods. The implication that allocation decisions will be biased in favor of voters with more asymmetric (concentrated) preferences still holds. However, it becomes more difficult to predict which group of voters will have the more concentrated preferences. Though it is reasonable to suppose the better-off have fewer public health service demands than do the poor, it is less clear that the better-off favor fewer macroeconomic policies, infrastructural projects, or electoral goods than the poor. In fact, the conventional notion that the poor are generally easier to buy with cheap, targeted electoral goods because of their disproportionate need for these goods compared to other policies (Stokes, 2005) is consistent with my asymmetry argument. But in this case, the poor make up the more asymmetric group. That is, the poor's demands with respect to electoral goods can be thought of as extremely concentrated on items required for immediate day-to-day survival. The interactions between this dynamic and the public service dynamics presented here deserve further investigation.

Finally, my research may be contrasted with the literature that models the probability of turnout as a function of preference intensity (Campbell, 1980; Lewis-Beck, Norpoth and Jacoby, 2009). Instead, I consider the implications of having voters with differing levels of preference asymmetry, where voters of all types participate equally in voting. However, it is worth noting that existing research on turnout dynamics could have ramifications that mediate the effects described by my model that I have not explored here. In particular, several researchers have found that when different social groups turn out at different rates it can produce significant deviations in electoral outcomes (Nichter, 2008; Power, 2009; In-

ternational Institute for Democracy and Electoral Assistance, 2011; Baez et al., 2012; de la O, 2013). These dynamics should be less important in countries that enforce compulsory voting, like Brazil. However, Power presents evidence that in Brazil, despite compulsory voting laws, the middle class and wealthy are more able to evade sanctions for abstaining from the vote (Power, 2009). If the middle class and wealthy are less likely to vote in Brazil than are the poor, this would attenuate the empirical spending implications predicted by my model. Both, in the Brazilian case and the more general application of the model, the interaction between the group concentration of service demands and group turnout dynamics also deserve further investigation.

Appendix

Appendix A: Proof of Optimality of x^*

The incumbent wants to choose x to satisfy

$$\underset{x}{\text{argmax}}\ w_P\Phi\left(\alpha^{\{P\}}+\beta_P^{\{P\}}x+\beta_H(1-x)\right)+(1-w_P)\Phi\left(\alpha^{\{W\}}+\beta_P^{\{W\}}x+\beta_H(1-x)\right).$$

First we must obtain the first order conditions. Applying the chain rule,

$$\begin{aligned}\frac{dE[V|x]}{dx} &= w_P(\beta_P^{\{P\}}-\beta_H)\phi\left(\alpha^{\{P\}}+\beta_P^{\{P\}}x+\beta_H(1-x)\right)\\ &+ (1-w_P)(\beta_P^{\{W\}}-\beta_H)\phi\left(\alpha^{\{W\}}+\beta_P^{\{W\}}x+\beta_H(1-x)\right).\end{aligned}$$

Setting this derivative equal to zero, we get

$$\begin{aligned}&w_P(\beta_P^{\{P\}}-\beta_H)\phi\left(\alpha^{\{P\}}+\beta_P^{\{P\}}x+\beta_H(1-x)\right)=\\ &-(1-w_P)(\beta_P^{\{W\}}-\beta_H)\phi\left(\alpha^{\{W\}}+\beta_P^{\{W\}}x+\beta_H(1-x)\right).\end{aligned}$$

Assuming that $1-w_P\neq 0$ and that $\beta_P^{\{W\}}-\beta_H\neq 0$ (both of which are conditions that hold by construction), it follows that

$$\frac{-w_P(\beta_P^{\{P\}}-\beta_H)}{(1-w_P)(\beta_P^{\{W\}}-\beta_H)}=\frac{\phi\left(\alpha^{\{P\}}+\beta_P^{\{W\}}x+\beta_H(1-x)\right)}{\phi\left(\alpha^{\{W\}}+\beta_P^{\{P\}}x+\beta_H(1-x)\right)},$$

which, since the left-hand term is greater than zero (as $w_P,\ 1-w_P>0$ and $\beta_H-\beta_P^{\{P\}},\beta_P^{\{W\}}-\beta_H<0$ by construction), further simplifies to

$$\begin{aligned}&2\log\left(\frac{w_P(\beta_H-\beta_P^{\{P\}})}{(1-w_P)(\beta_P^{\{W\}}-\beta_H)}\right)=\\ &\left(\alpha^{\{P\}}+\beta_P^{\{P\}}x+\beta_H(1-x)\right)^2-\left(\alpha^{\{W\}}+\beta_P^{\{W\}}x+\beta_H(1-x)\right)^2,\end{aligned}$$

Expanding and combining terms we get the quadratic form

$$\begin{aligned} x^2[(\beta_P^{\{P\}} &- \beta_H)^2 - (\beta_P^{\{W\}} - \beta_H)^2] \\ &+ x\left[2(\alpha^{\{P\}} + \beta_H)(\beta_P^{\{P\}} - \beta_H) - 2(\alpha^{\{W\}} + \beta_H)(\beta_P^{\{W\}} - \beta_H)\right] \\ &+ (\alpha^{\{P\}} + \beta_H)^2 - (\alpha^{\{W\}} + \beta_H)^2 - 2\log\left(\frac{w_P(\beta_H - \beta_P^{\{P\}})}{(1-w_P)(\beta_P^{\{W\}} - \beta_H)}\right) = 0. \end{aligned}$$

Solutions for x^* are thus accessible using the quadratic formula,

$$x^* = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a},$$

where

$$\begin{aligned} a &= (\beta_P^{\{P\}} - \beta_H)^2 - (\beta_P^{\{W\}} - \beta_H)^2, \\ b &= 2(\alpha^{\{P\}} + \beta_H)(\beta_P^{\{P\}} - \beta_H) - 2(\alpha^{\{W\}} + \beta_H)(\beta_P^{\{W\}} - \beta_H), \text{ and} \\ c &= (\alpha^{\{P\}} + \beta_H)^2 - (\alpha^{\{W\}} + \beta_H)^2 - 2\log\left(\frac{w_P(\beta_H - \beta_P^{\{P\}})}{(1-w_P)(\beta_P^{\{W\}} - \beta_H)}\right). \end{aligned}$$

The optimal strategy must lie in the interval $[0, 1]$, which makes it possible to select the logical solution from the two quadratic formula outputs (which turns out to be the larger of the two outputs). Since x cannot be less than zero or greater than one, the solution provided sometimes produces corner solutions ($x = 0$ when the optimum is less than zero and $x = 1$ when the optimum is greater than one).

Next we must prove the second order conditions, that the second derivative of $E[V|x]$ evaluates to a negative number at the proposed x^*. Taking the second derivative of $E[V|x]$, we get

$$\begin{aligned}\frac{dE[V|x]}{dx} &= \frac{w_P(\beta_P^{\{P\}}-\beta_H)}{\sqrt{2\pi}}\left[-\frac{1}{2}\left(2(\beta_P^{\{P\}}+\beta_H)(\beta_P^{\{P\}}-\beta_H)+2x(\beta_P^{\{P\}}-\beta_H)^2\right)\right]* \\ &\exp\left\{-\frac{[(\alpha^{\{P\}}+\beta_H)^2+2x(\alpha^{\{P\}}+\beta_H)(\beta_P^{\{P\}}-\beta_H)+x^2(\beta_P^{\{P\}}-\beta_H)^2]}{2}\right\}+ \\ &\frac{(1-w_P)(\beta_P^{\{W\}}-\beta_H)}{\sqrt{2\pi}}\left[-\frac{1}{2}\left(2(\beta_P^{\{W\}}+\beta_H)(\beta_P^{\{W\}}-\beta_H)+2x(\beta_P^{\{W\}}-\beta_H)^2\right)\right]* \\ &\exp\left\{-\frac{[(\alpha^{\{W\}}+\beta_H)^2+2x(\alpha^{\{W\}}+\beta_H)(\beta_P^{\{W\}}-\beta_H)+x^2(\beta_P^{\{W\}}-\beta_H)^2]}{2}\right\}.\end{aligned}$$

We know that the exp operator produces positive output and that $\beta_P^{\{P\}} > \beta_H$ by construction, so the first term is negative for all x, including for x^*. If the second term in the expression is also negative when evaluated at x^* then we know the whole expression is negative, which is a sufficient condition to prove the solution is a maximum. Since $\beta_P^{\{W\}} < \beta_H$ by construction, the second term evaluates to a negative number at x^* only if

$$2(\alpha^{\{W\}}+\beta_H)(\beta_P^{\{W\}}-\beta_H)+2x^*(\beta_P^{\{W\}}-\beta_H)^2 < 0,$$

which is true as long as

$$x^* > \frac{\alpha^{\{W\}}+\beta_H}{\beta_P^{\{W\}}-\beta_H}.$$

This condition holds for all the comparative statics shown in this paper.

Appendix B: The Non-recipient Poor Counterfactual

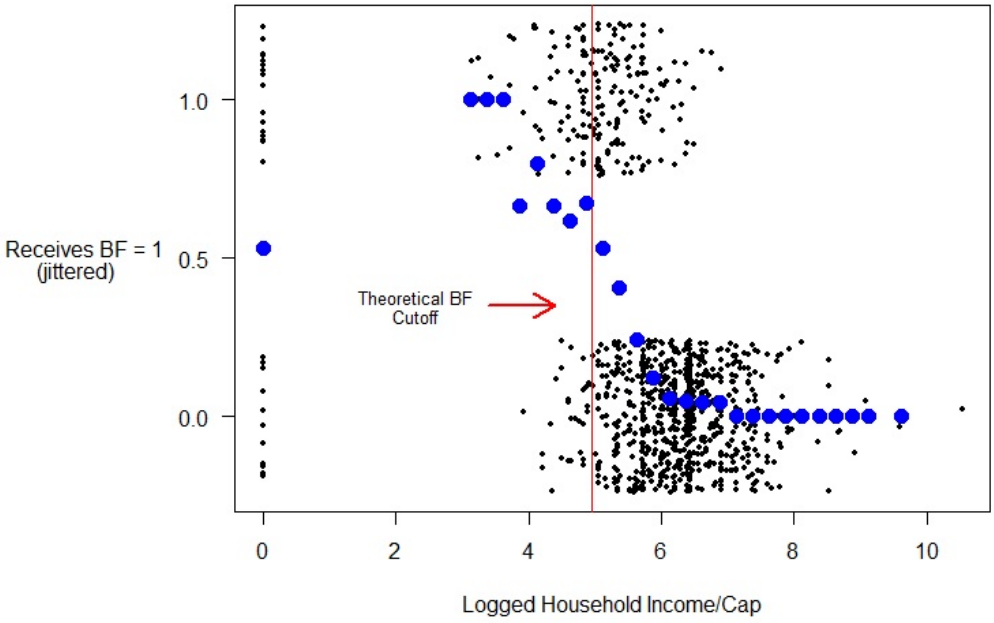
Do the non-recipient poor provide a fair counterfactual for the recipient poor? *Bolsa Família* is a means-tested income-based program, so theoretically a precise income threshold should

separate recipients and non-recipients, raising the concern that recipients and non-recipients are somehow fundamentally different types of voters. In fact, since assignment is limited by the information available to the federal government there is considerable quasi-random noise in the assignment mechanism. Random audits of beneficiaries exist, but the government has to rely on official (formal) employment records to verify the accuracy of assignment. Recall that somewhere in the neighborhood of 43.8% of Brazilians have some informal income (Paim et al., 2011). The likelihood of having at least one source of informal income in a household tends to increase as one gets poorer and decrease as one gets wealthier. Therefore, even the type of unbiased assignment mechanism said to exist in federal *Bolsa Família* allocation (Fried, 2012), will be subject to noise in the form of measurement error from hidden income sources. Since the noise introduced by informal income ought to decrease as a household gets richer, the probability of erroneous assignment should also decrease with household wealth. Furthermore, the Program's income registration records are only updated every two years, which is a source of additional noise in assignment due to the fact that the poor have volatile incomes (Soares, Ribas and Osório, 2010).

Using the survey data described later in the "Data" section, we may examine the probability of assignment to recipient status as a function of income. In Figure 6.1 below, I plot the proportion of survey respondents that report receiving *Bolsa Família* income across bins of logged (pre-transfer) per capita household income. I use logged income for this visualization due to the large degree of right skewness in the income distribution in Brazil. The figure shows a probability less than one of receiving the transfer for those who fall below the official program cutoff.

The figure below (measured in original unlogged household income per capita in Brazilian *reais*) zooms in on the subset of the sample that I classify as "poor"—those with per capita household incomes below one-half of the monthly minimum wage. It plots the probability of assignment to recipient status for the poor as a smooth function of per capita household income. Though not perfectly monotonic, the plot indicates that assignment to recipient status is a relatively smooth decreasing function of income. The area shaded in blue is the bootstrapped 95% confidence interval.

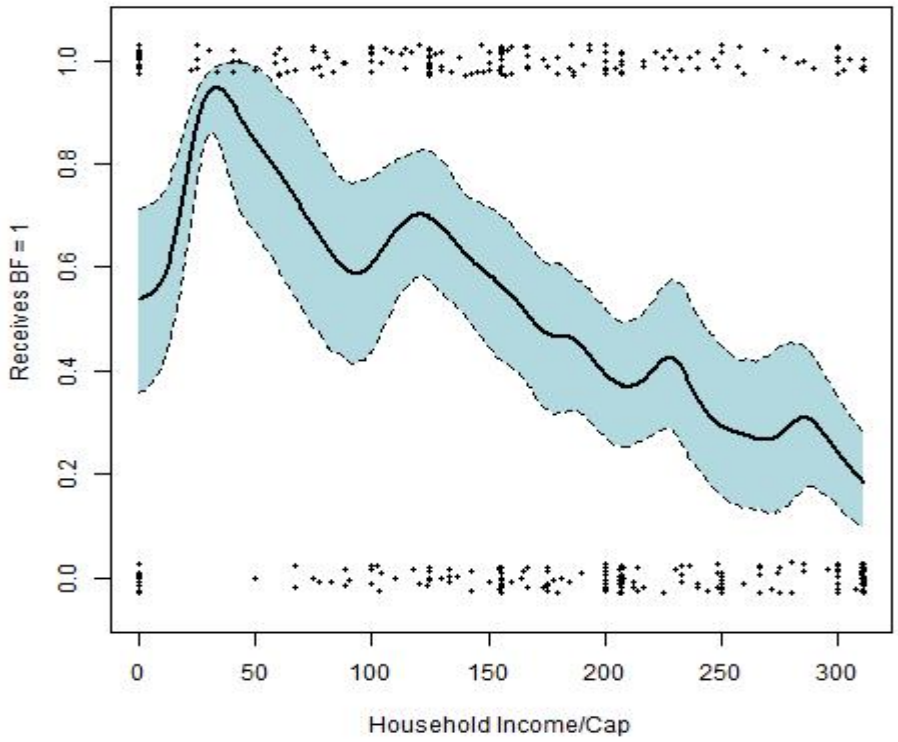
Figure 6.1: Probability of Receiving Bolsa Familia by Pre-Transfer Income



I estimate that 56.7% of the poor constituency in the sampling frame receives *Bolsa Família* income.[1] This is consistent with reports that *Bolsa Família* is well-targeted. The World Bank estimates that 94% of recipients are among the poorest 40% of the population (based on all income sources) (Lindert et al., 2007). This is a good targeting outcome, but it also reflects a fair amount of noise in assignment. About 25% of Brazilians live in households that receive *Bolsa Família* income (Lindert et al., 2007). If the program were perfectly targeted without assignment noise, then 100% of recipients would be in the poorest 25% of the population. Taken together, this evidence suggests that non-recipients do provide a good counterfactual for recipients, so long as one controls for a continuous measure of pre-transfer household income per capita, which I do.

[1]I calculate the probability of receiving *Bolsa Família* given one's income nonparametrically, using a normal kernel density smoother with the optimal bandwidth suggested by Scott (Scott, 1992). I then compute the predicted probability of assignment for each observation (given income level) in the poor constituency. I use these predicted probabilities for each observation to compute an expected probability of receiving *Bolsa Família* for the whole poor constituency in the sampling frame by computing the inverse-probability-weighted average of these predicted values.

Figure 6.2: Pr(Recipient|Household Income per Cap)



Appendix C: Data

Survey Data

The dependent variable, vote choice, must be observed at the individual level. The main independent variables argued to condition service responsiveness, household income per capita and the family's *Bolsa Família* status, must be observed at the household level. Since by law election day ballots are cast in secret, survey data is the necessary vehicle for vote choice measurement. Survey methods are also conducive to household data-collection. I implemented a survey in the field prior to the municipal elections held in Brazil on October 7th, 2012 to elicit intended vote choice from eligible voters. This measure is inherently noisy, since many voters still report themselves to be undecided before election day. I limited the survey period to the two weeks leading up to the elections in attempt to minimize this type

of noise.

Since this is a study of individual behavior in response to mayoral strategic distribution, the sampling design had to balance two inferential objectives that were often at odds with each other: individual-level inference and municipal-level inference. Municipalities with larger populations and geographies, namely large cities, may also have more demographic variability. Population-weighted sampling across municipalities is therefore important for the purpose of capturing the full range of demographic influence on individual vote choice. However, individual dynamics in a municipality will also be driven by municipal-level factors, including municipal-level health spending, population size, and the percent of the municipal population that is poor. Thus, the population weights on within-municipality sample size should not be so disparate across municipalities as to exacerbate problems of small-area estimation for smaller municipalities. In addition to a partial-pooling estimation strategy, I also attempt to arbitrate between these concerns in the sampling design.

Appendix D: Sampling Design

The respondents were chosen via probability sample using a clustered, stratified, multistage design (see Appendix 6 for design summary). For reasons of feasibility, I chose to implement the survey in only one Brazilian state. Limiting the sampling pool to one state makes it possible to hold state-level factors constant while focusing on municipal dynamics. To increase the viability of out-of-sample municipal-level inference, I chose the state in which the distribution of target coverage rates for *Bolsa Família* across municipalities most closely reflects the country-wide distribution. That state is Minas Gerais (see Appendix 6 for a comparison of the twenty-six Brazilian states on this measure). Though no single state in Brazil is a true microcosm of the country, Minas Gerais may come the closest with respect to regional variation in development and income levels. Though Minas has a strong cultural identity of its own, the southern and western parts of the state are highly developed and culturally reminiscent of the industrial states of São Paulo, Rio de Janeiro and Goiás. In stark contrast, the northern and eastern municipalities are poorer, more rural, and seem to

have more in common both culturally and economically with their northern neighbor, Bahia, than with the south of Minas Gerais.

Figure 6.3: Percentage of Families Qualifying for *Bolsa Família* by Municipality in 2010

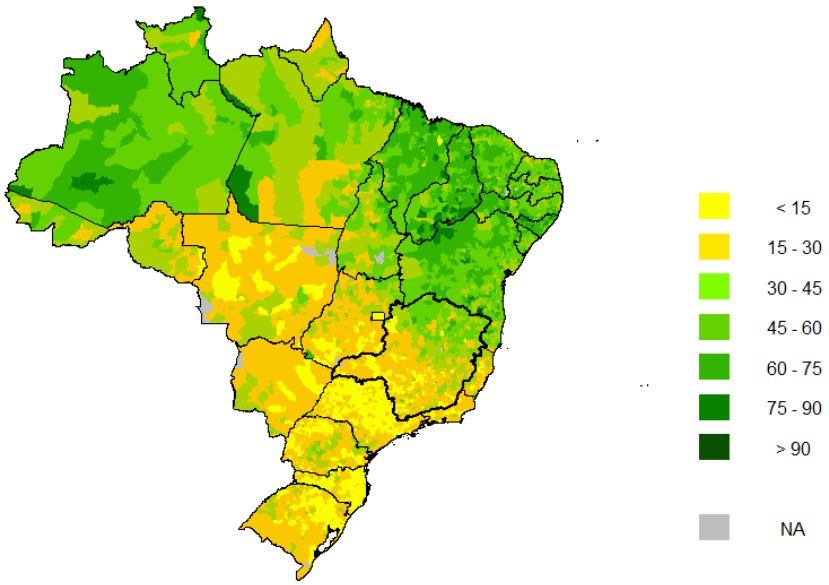


Figure 6.3 shows that Minas Gerais is also the state with the most variation across municipalities in the percentage of families that qualify for *Bolsa Família* benefits. Sampling municipalities from Minas Gerais (as opposed to, say, São Paulo) helps ensure that the sample covers municipalities from the full development spectrum. Furthermore, since this paper attempts to estimate the effects of primary care spending on both the poor and the better-off, it is important that both of these groups are well-represented in the sample.

Within Minas Gerais, I conducted the sampling without replacement in four stages: municipalities, census tracts, households and individuals. The sampling frame for municipalities included all municipalities in Minas Gerais in which more than one candidate contested the mayoral election and in which one of these candidates was the incumbent mayor.[2] I divided these municipalities into nine strata according to the mayor's party and

[2]Mayors are limited by law to a single consecutive re-election. Though most mayors do attempt re-election, this frame excludes municipalities in which the incumbent is termed-out by law or is legally disqualified by the Brazilian court system.

the percentage of families in the municipality that qualify for *Bolsa Família* benefits or, $s \in \{PT, Coalition, Opposition\} \times \{0-25\%, 25-50\%, >50\%\}$.[3] Within strata, I sampled municipalities with probability weights proportional to the size of the municipality's eligible voter population. Appendix 6 provides details on the sample, including a table showing the number of municipalities sampled within each strata and a complete enumeration of sampled municipalities.

Second, within each sampled municipality, I sampled census tracts with probability weights proportional to the size of the tract's eligible voter population. The number of sampled tracts selected per municipality was proportional to the *square root* of the tract's eligible voter population (to allow for oversampling in smaller municipalities to improve municipal-level inference). Appendix 6 lists the number of census tracts sampled per municipality. Within the selected tracts, I sampled eight households with equal probability from a complete enumeration of domiciles assembled by the IBGE during the 2010 Census. Finally, the last stage of sampling was completed in the field. Native Brazilian-Portuguese-speaking enumerators visited the sampled domiciles and, using a random number table, sampled one respondent with equal probability from among the household's eligible voter population.

The trained enumerators then conducted face-to-face interviews with consenting respondents in order to elicit survey responses.[4] Whenever possible, the interviews were conducted without the presence of others. Enumerators returned once to the domicile if the sampled individual was not available upon first visit. Those that declined participation were replaced by a new household using the same sampling procedure. The first question asked respondents who they would vote for for mayor on October 7^{th}.[5] They were provided both a written and verbal list of local candidates, identified by both their official ballot name and number. Respondents had the option to respond verbally with the name or candidate number of their choice, or to indicate the answer by pointing. About half of the 1,199 respondents indicated

[3]The *Partido dos Trabalhadores*, or PT, is the presidents party. If the mayor is not from the president's party, I classify his party as either in the president's national coalition (included in the Cabinet) or the opposition.

[4]The use of home visits enabled the participation of poor families without Internet or phone access as well as illiterate respondents.

[5]This ordering was intentional to avoid possible short-term priming effects from the topics of social assistance and health care, which came up later in the survey.

they had not yet decided.

Valid survey inference from a probability sample depends on the representativeness of that survey, once accounting for the probability of being included in the sample. To evaluate the validity of inference from the survey with respect to the sampling frame described above, Appendix 6 compares (inverse-sampling-weighted) descriptive statistics from the survey with Census and Ministry of Social Development data for demographic variables describing the sampling frame. Appendix 6 plots the incumbent's predicted vote share (calculated from the pre-election survey sample) and compares this to his observed vote share on election day.[6]

Public Finance Data

The municipal budget itemized expenditure data comes from the records of the National Treasury of Brazil. These records divide municipal expenditures into functions of the municipal government, such as "health." They further divide these functions into subfunctions, such as "primary care" and "hospital care." I use these two subfunctions. My measure of total health spending is the sum of the two. Averaging across municipalities, these two subfunctions account for 84% of all municipal expenditures on health, the remainder primarily being administrative and research costs of "health surveillance."

Population Measures

The measurements of population size and of the percentage of families in the municipality that I classify as poor come from Brazilian census data from 2010. The census data provide counts of the number of households in each municipality that earn a monthly per capita income that falls within a certain range on the minimum wage scale. Brazil has no official "poverty line," however, the cutoff of one-half of the monthly minimum wage in household per capita income is a measure commonly-used for this purpose (Lula da Silva, 2012). This measure is also judged by the IBGE to be a reasonable proxy for overall vulnerability,

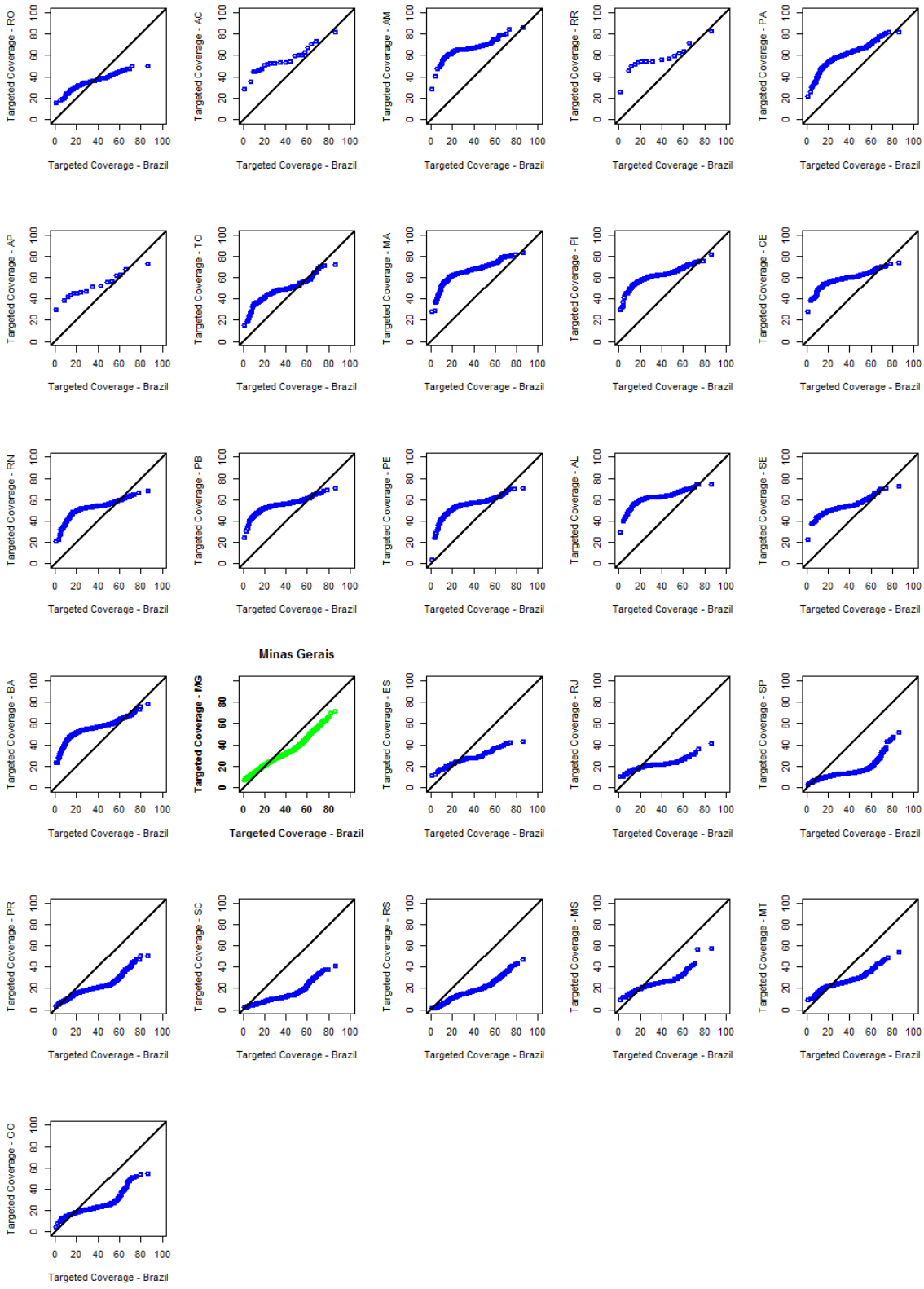
[6]Note that the research design is not meant to support a fully separating analysis of the data within each of the 38 municipalities. Within-municipality sample-size ranges from a low of 16 respondents to a high of 214, dependending on municipality size.

capturing the majority of families coping with precarious housing or sanitation conditions (Pinto de Oliveira, 2010). About 32% of all households in Brazil fall into this category according to the 2010 census data (Instituto Brasileiro de Geografia e Estatística, 2010).

Appendix E: Selection of Minas Gerais

The "target coverage rate" for a Brazilian municipality measures the percentage of the municipal population that qualifies for *Bolsa Família* benefits according to estimates from Brazil's Ministry of Social Development and Welfare. Figure 6.4 shows quantile-quantile plots for each state in Brazil comparing the distribution of target coverage rates for all the municipalities in each state with the distribution of target coverage rates in all of Brazil. If the shape of the distribution of municipalities in a state is the same as the shape of the distribution of all municipalities in Brazil, the Q-Q plot will be a 45 ° line (included in black for reference). Of all the states, Minas Gerais comes closest to approaching this theoretical ideal.

Figure 6.4: Quantile-Quantile Plots of Targeted Municipal *Bolsa Família* Coverage Rates



Appendix F: Sampling Design Summary

Sampling Frame

Eligible voters (i.e., citizens aged 16 years and up) in all of the census tracts in Minas Gerais that fall within municipalities in which the incumbent mayor is running for re-election and in which at least two candidates are competing for the position of mayor, excluding "special census tracts" (hospitals, military barracks, prisons, orphanages, etc).

Sampling Methodology

The sampling was implemented using a stratified, clustered multi-stage probability sampling design. The four stages are outlined below.

First Stage

In the first stage, I sampled from municipalities in which the incumbent mayor ran for re-election and in which at least two candidates competed for the position of mayor. Within municipal strata, I used sampling weights proportional to the size of the municipal population with at least 16 years of age. The municipalities are stratified on the incumbent candidate's party (either *Partido dos Trabalhadores*, Coalition, or Opposition) and the percentage of the families in the population that qualify for Bolsa Família benefits (either 0-25%, 25-50%, or over 50%). The sampling allocation of municipalities within strata oversamples municipalities with PT incumbents and oversamples municipalities with greater than 50% of the population qualifying for Bolsa Família.

Table 6.1: Number of Municipalities Sampled within Strata

		Mayor's Party Affiliation			
		PT	Coalition	Opposition	Total
Percent of Families Qualified for *BF*	$0-25\%$	5	4	4	13
	$25-50\%$	3	4	5	12
	$>50\%$	3	5	5	13
	Total	11	13	14	**38**

Second Stage

Within sampled municipalities, I sampled census tracts with probability proportional to the size of the eligible voter population of the tract. The number of tracts sampled in each municipality is proportional to the square root of the size of the eligible voter population of the municipality (smaller municipalities are oversampled to deal with issues of small area inference).

Third Stage

Within sampled tracts, I sampled households with equal probability for each housing unit.

Fourth Stage

Within sampled households, enumerators sampled an individual respondent with equal probability from all eligible voters in the household.

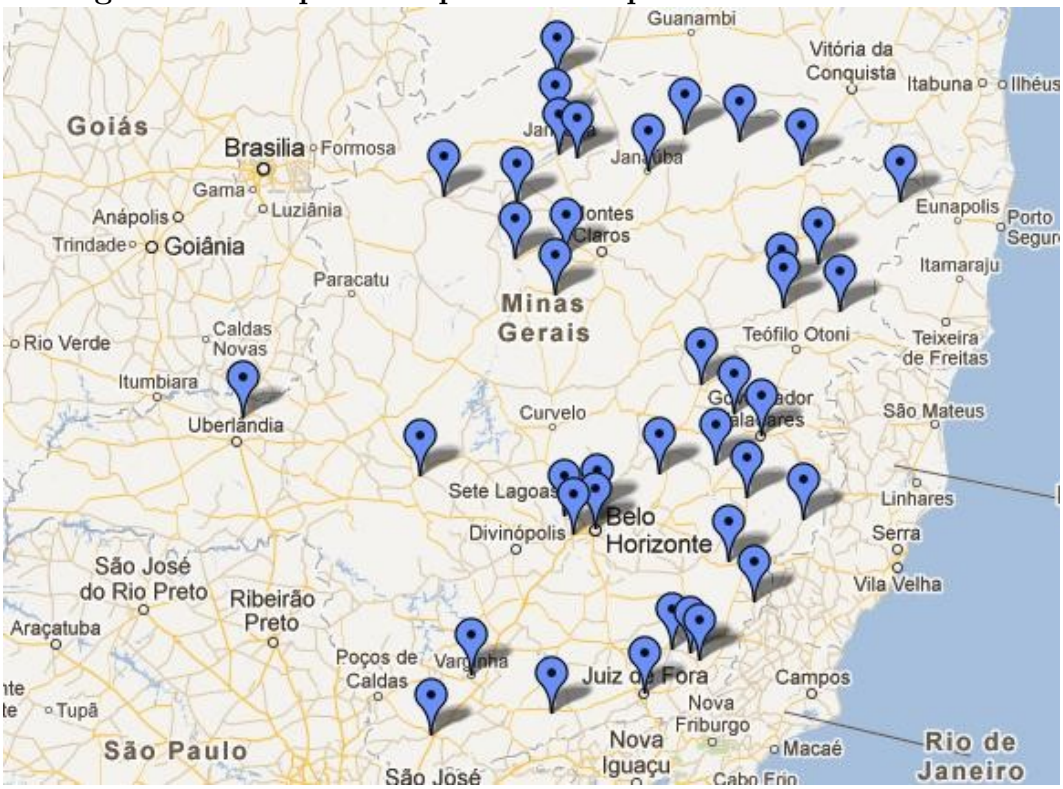
Sample Size

A sample of 1199 respondents were interviewed from 146 census tracts. The initial sample included 150 census tracts (aiming for 1,200 respondents—eight from each tract). However, I dropped one municipality from the sample shortly before enumeration began when the incumbent mayor was disqualified from the election by the Brazilian court system. I therefore instructed enumerators that visited the northeast of Minas Gerais to oversample from their census tracts to compensate and this alteration was included in the calculation of the inverse sampling weights.

Appendix G: Sampled Municipalities

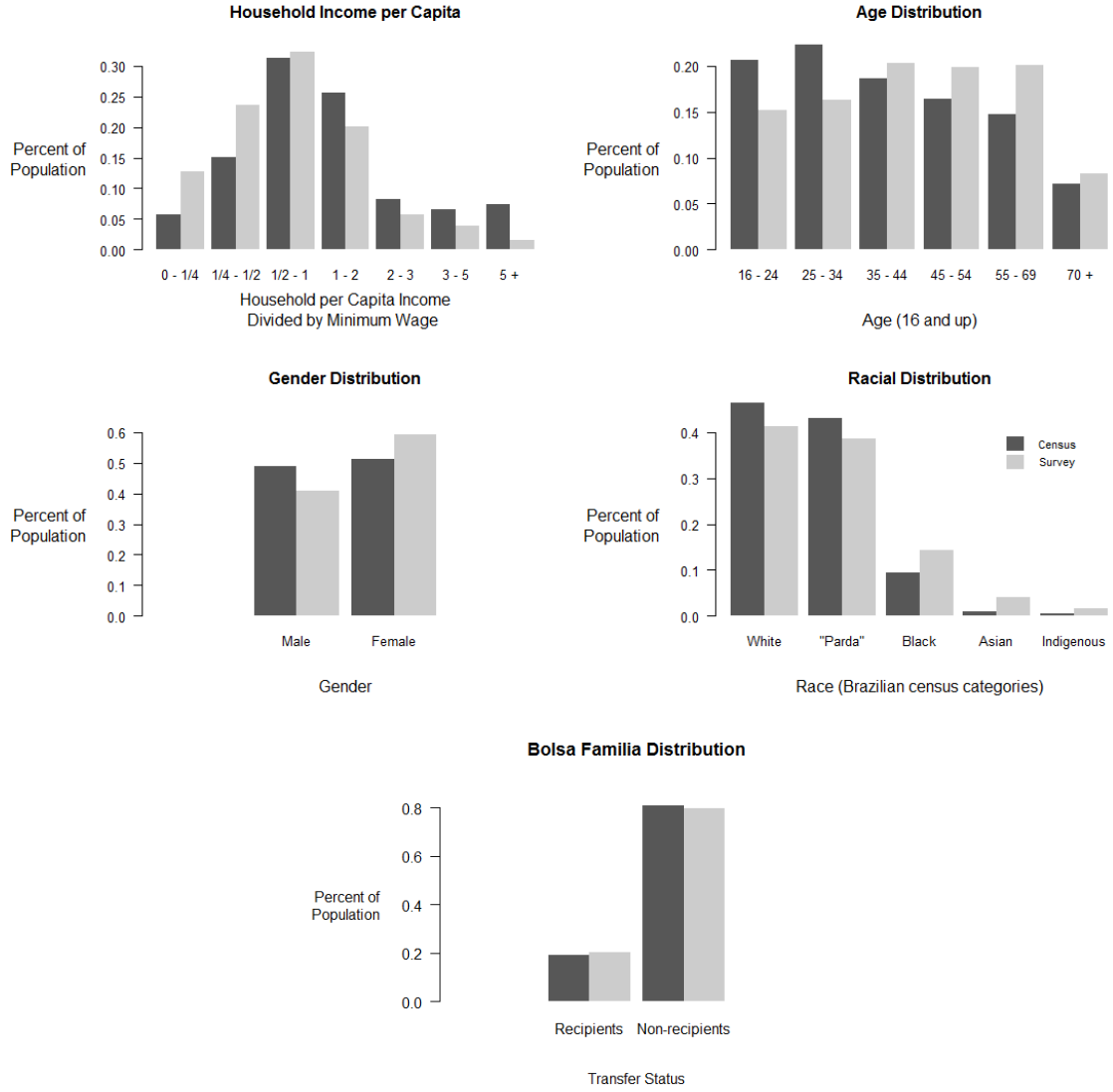
Municipality	Census Tracts Awarded (Total = 146)
AGUAS VERMELHAS	2
ARAGUARI	5
BELO HORIZONTE	26
BELO ORIENTE	2
BETIM	10
CARAI	2
CARANGOLA	3
CARVALHOS	2
CATAGUASES	4
CONEGO MARINHO	2
COROACI	2
DONA EUSEBIA	2
ESMERALDAS	4
GOVERNADOR VALADARES	8
IBIAI	2
IBIRACATU	2
ICARAI DE MINAS	2
INDAIABIRA	2
INHAPIM	2
ITAIPE	2
JACINTO	2
JANAUBA	4
JEQUITAI	2
JUIZ DE FORA	12
MATIPO	2
MONTE FORMOSO	2
MUTUM	2
PAVAO	2
PEDRAS DE MARIA DA CRUZ	2
PIRAUBA	2
POUSO ALEGRE	6
SAO GOTARDO	3
SAO JOAO DA LAGOA	2
SAO JOSE DE JACURI	2
SAO SEBASTIAO DO RIO PRETO	2
URUCUIA	2
VARGINHA	6
VESPASIANO	5

Figure 6.5: Map of Sampled Municipalities in Minas Gerais



Appendix H: Descriptive Statistics

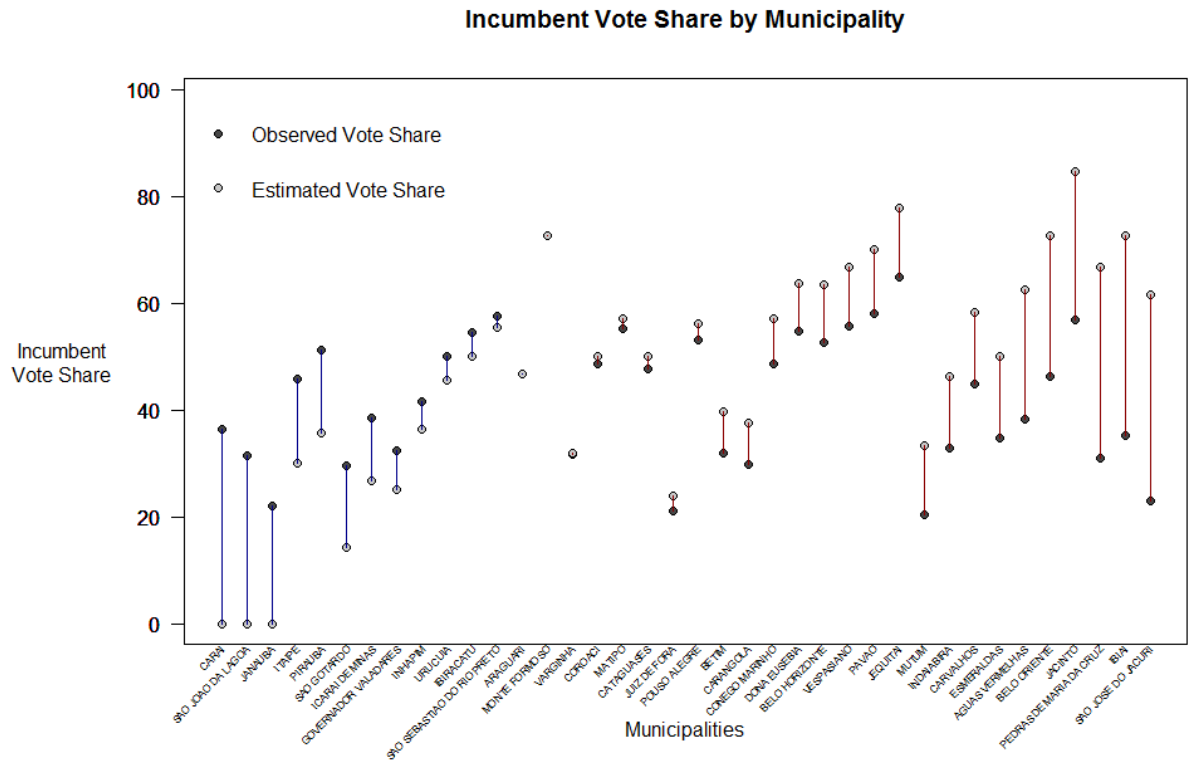
Figure 6.6: Comparing Survey Estimates with Census Data for Sampling Frame



Note: The survey data are weighted by inverse sampling weights. I have excluded those that declined to respond to the survey question. This includes 24% of survey responses for income and under 3% of survey responses for race. The other categories pictured had complete response data.

Appendix I: Vote Share Descriptive Statistics

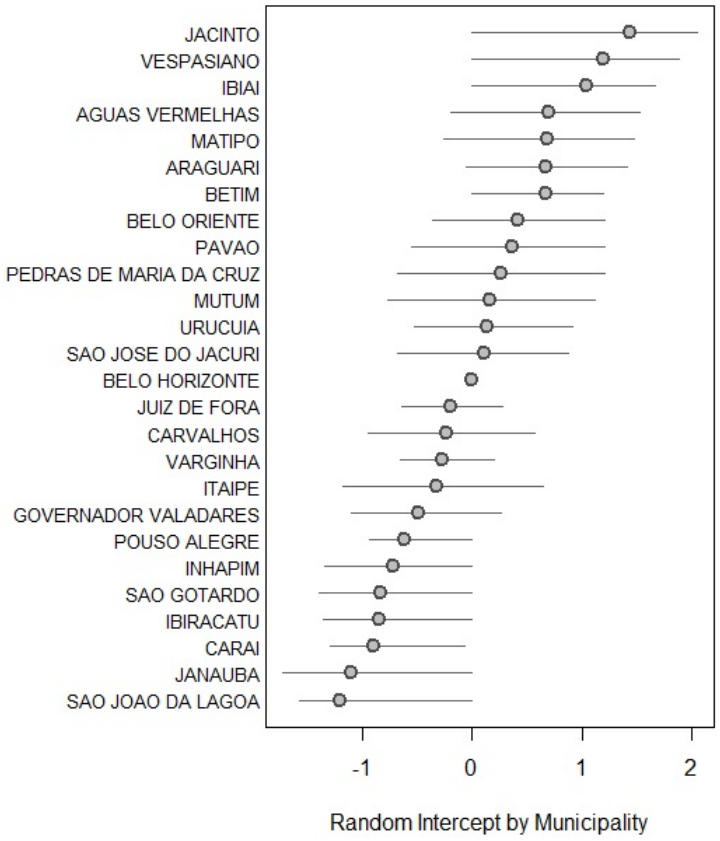
Figure 6.7: Comparing Survey Estimates with Election Outcome



Note: Blue lines show the distance between the predicted and observed incumbent vote shares where the prediction underestimated the outcome; red lines show the size of overestimates.

Appendix J: Random Intercept Components

Figure 6.8: Underlying Popularity of Incumbent Mayor



Note that the line segments are bootstrapped 95% confidence intervals. Also note that Belo Horizonte appears as the baseline because I have modeled its deviation from the grand mean as a fixed effect, since it received notably more national attention than any of the other sampled municipalities.

Appendix K: Non-EM Hierarchical Results

Table 6.2: Non-EM Hierarchical Probit Results

Variable	Coef
Underlying Propensity to Favor Incumbent	
$\alpha^{\{p\overline{R}\}}$ (Intercept: Poor Non-Recipient)	0.175 0.943 (2.455)
$\alpha^{\{pR\}}$ (Intercept Shift: Recipient)	0.026 0.923 (0.270)
$\alpha^{\{w\}}$ (Intercept Shift: Better-off)	0.540** 0.027 (0.245)
Responsiveness to Primary Care Spending	
$\gamma^{\{p\overline{R}\}}$ (Poor Non-Recipient)	0.001 0.777 (0.003)
$\gamma^{\{pR\}}$ (Poor Recipient)	-0.005** 0.011 (0.002)
$\gamma^{\{w\}}$ (Better-off)	-0.003** 0.024 (0.001)
Responsiveness to Hospital Spending	
ψ Change in Total Health Spending/Cap	0.004 0.371 (0.004)
Health Expenditure Context	
λ_1 Total Health Spending/Cap 2011	-0.001 0.735 (0.002)
λ_2 Primary Care Spending/Poor Head 2011	0.001** 0.044 (0.0004)
Municipal Vote Predictors	
λ_3 Municipal Population (Logged)	-0.076 0.650 (0.166)
λ_4 Percent of Pop Classified as Poor	0.007 0.653 (0.016)
λ_5 Dummy for State Capital	0.846 0.327 (0.863)

Continues

Continued from previous page

Variable	Coef
Individual Vote Predictors	
λ_6 Co-Partisan with Mayor	1.840***
	0.000
	(0.288)
λ_7 Household Income/Cap (Logged)	-0.213**
	0.023
	(0.094)
λ_8 Age	0.011**
	0.017
	(0.005)
λ_9 Female	0.260*
	0.073
	(0.260)

Note: Reported values include the estimate, p-value, and standard error. The ***,**, and * notation denotes statistical significance for a two-tailed t-test (0.01, 0.05, and 0.10 α levels, respectively). The model includes 399 observations with complete data. The standard deviation of the random intercept is estimated to be 0.452.

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