LEFT, RIGHT, LEFT: INCOME DYNAMICS AND THE EVOLVING POLITICAL PREFERENCES OF FORWARD-LOOKING BAYESIAN VOTERS

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Abstract

The political left turn in Latin America, which lagged its transition to liberalized market economies by a decade or more, challenges conventional economic explanations of voting behavior. While the implications of upward mobility for the political preferences of forward-looking voters have been studied, neither the upward mobility model nor conventional myopic median voter models are well equipped to explain Latin America's political transformation. This paper generalizes the forward-looking voter model to consider a broad range of dynamic processes. When voters have full information on the nature of income dynamics in a transition economy, we show that strong support for redistributive policies will materialize rapidly if income dynamics offer few prospects of upward mobility for key sections of the electorate. In contrast, when voters have imperfect information, our model predicts a slow and politically polarizing shift toward redistributive voter preferences under these same non-concave income dynamics. Simulation using fitted income dynamics for two Latin American economies suggests that the imperfect information model better accounts for the observed shift back to the left in Latin America, and that this generalized, forward-looking voter approach may offer additional insights about political dynamics in other transition economies.

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1. INTRODUCTION

Most Latin American countries had transitioned to market economies by the early 1990's. The largely center right political leadership that instituted these transitions continued to win national elections and persisted in power throughout the 1990s and into the early 2000's. Since that time, electoral politics have turned sharply left. The recent suite of presidential elections have seen left-leaning candidates defeat more conservative opponents in Brazil, Bolivia, Chile, Ecuador, El Salvador, Honduras, Nicaragua, Paraguay, Peru and Venezuela.[1] Not only have these elections ushered in a political shift, they have in many instances been hotly contested by candidates offering fundamentally different economic visions. The goal of this paper is to provide a theoretical framework to help us understand the economic forces that underlie these complex political dynamics.

The influential body of political economy literature that focuses on economic inequality as a force that determines both political institutions and voting patterns would seem to offer a window into these political patterns [Acemoglu and Robinson, 2006, Boix, 2003]. However, the fact that inequality measures tend to be remarkably stable over time makes it unlikely that inequality can explain the right-left voting dynamics of Latin America. A recent paper by Robert Kaufman [2009] confirms the inconvenient empirical fact that existing measures of economic inequality do a very poor job of explaining both political institutions and voting patterns in Latin America.

Although we could abandon the search for economic explanations of contemporary voting patterns and appeal to other factors to explain them, we instead take our cue from the Benabou and Ok [2001] model of voters as forward-looking agents, who have full information about their economy's income distribution dynamics, and who formulate their political preferences based on how redistribution will influence their future income streams. From this perspective, voters should be driven by income dynamics, not by the current level of income inequality or other features of the contemporaneous income distribution.[2]

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[1]While the contemporary Latin American left cannot be defined by a shared economic model, this new left does share a largely populist impulse and desire to shift resources and opportunity to those at the bottom of the income distribution. For instance, Greene and Baker [2009] construct vote revealed leftism (VRL) from ideological ratings of presidents and parliamentary parties in Latin America from 1996-2008, showing that the left has an economic policy mandate to halt or partially reverse neoliberal economic policies.

[2]Fields [2007] makes this point even more strongly by showing how inequality can increase during the early stages of a period of upward mobility that would surely dampen political preferences for redistribution.

Benabou and Ok specifically show that concave income distribution dynamics that offer the prospect of upward mobility (or, POUM) can account for anti-redistribution conservatism.[3] Under POUM, forward-looking voters who would benefit from redistribution in the short run do not benefit in the long run and therefore vote against long term redistributive policies. A first contribution of this paper is to generalize the class of income transition functions considered by these authors. We show that non-concave income transition functions of the sort suggested by poverty trap theory, which offer no prospect of upward mobility (or, No-POUM), can result in a surprisingly and increasingly redistributive electorate.[4] Our result shows that redistributive dynamics are determined by smoothed envelopes drawn around income transition functions. This result generalizes the connection between redistribution and income beyond the usual concepts of concavity and convexity.

In an effort to corroborate this theoretical intuition, we calibrate a simple class of income dynamics to Latin American countries. These estimates indeed reveal the sort of No-POUM dynamics that would be expected to generate an increasingly pro-redistribution electorate. Surprisingly, applying these dynamics to our full information, forward-looking voting model indicates that the demand for redistribution should have been stronger and should have occurred well in advance of the recent suite of Latin American presidential elections. This result presents a puzzle that questions fundamental assumptions about how economic voters process and react to economic prospects. A second contribution of this paper is to explore this puzzle within a rational voter framework.

We argue it is the assumption that voters have full information about their economy's income distribution dynamics that is most problematic, especially in transition economies where the electorate had little prior experience of a liberalized market economy (e.g. Przeworski, 1991). In such circumstances, voters have little choice but to fall back on priors about how such an economy might work.[5] In Latin America, the shift to the liberal economic model was put forward on the grounds that it would boost incomes and well being

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[3]Complementary endogenous explanations for anti-redistributive positions include disincentives for labor supply as typified by Meltzer and Richards [1981], asset formation [Persson and Tabellini, 1994], inefficient levels of public goods [Alesina and Rodrik, 1994], multidimensional policy spaces in which non-economic preferences conflict with pocketbook voting [Roemer, 2001]. To highlight the roles of income dynamics and learning, we ignore the incentive effects of taxation, but do account for the role of deadweight loss.

[4]Indeed, Tucker [2006] shows that voting in the post Soviet bloc reflects economic experiences: areas with poor economic outcomes tend to support "Old Regime" parties while good outcomes provide support for liberal "New Regime" parties.

[5]Our approach to modeling ideology as an idiosyncratic evolving process echos Bates et al. [1998] as a means to complement cultural and ideological political theories with rational choice. The Latin American case is also compounded by a recent history of autocracy which likely bounded the range of publicly admissible ideologies, a possibility easily modeled in our framework.

for all, including the lower half of the income distribution.[6] Assuming that voters begin with this "POUM prior," we go on to model voters as Bayesian learners who experientially update their expectations based on their own stochastic income experience. Leveraging the POUM and No-POUM distinction, we characterize "Left" vs "Right" Bayesian beliefs about income dynamics. We show that this model of forward-looking, Bayesian voters offers an empirically tenable explanation of the recent right to left political evolution in Latin America. A key ingredient in this explanation is that dead weight loss induces political volatility in uncertain environments, a new effect that the voter learning approach reveals. While increased dead weight loss reduces support for redistribution for both right and left voters, the effect is stronger for right voters and further polarizes the electorate.

The remainder of this paper is organized as follows. Section 2 develops a basic framework for individual and aggregate income dynamics in the presence of transient shocks, and models political support for redistributive policies by both myopic and forward-looking voters who enjoy full information about the income dynamic process. Section 3 then introduces both concave (POUM) and poverty trap (No-POUM) dynamics, and derives results on the political preferences of fully-informed, forward-looking voters. The analysis of Section 3 is applied to Latin American income dynamics in Section 4. Section 5 then relaxes the full information assumption, and explores political dynamics when voters learn about the true income distribution dynamics that characterize their economy. Section 6 shows this model of forward-looking Bayesian voters who confront a No-POUM world can give rise to the political polarization and sudden political shifts that have been observed in 21st century Latin America. Section 7 concludes.

2. FORWARD-LOOKING VOTERS AND THE DEMAND FOR REDISTRIBUTION

This section lays out machinery needed to discuss changing patterns in majoritarian voting when the electorate can choose among income redistribution schemes. Our emphasis is the role of income dynamics, rather than static measures of inequality (e.g. Moene and Wallerstein [2001]). The setting is a continuum of voters whose incomes evolve over time and fluctuate with idiosyncratic shocks each period. Voters care only about maximizing the present discounted value of income from all sources, whether public or private, and are thus "pocketbook voters." We consider the fraction of the voter population who rationally prefer income redistribution, which we term the demand for redistribution.

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[6]See for example Williamson 1990 [Williamson, John, 1990, "What Washington Means by Policy Reform," in Latin American Adjustment: How Much Has Happened? edited by J.Williamson (Washington: Institute for International Economics)] for a classic statement of the so-called Washington Consensus about the desirability of liberal economic policies for Latin America.

In order to evaluate a particular redistributive policy, each voter considers three things: their individual income path, the aggregate income path of the economy and the longevity of the policy. Changes in the economy over time thereby induce changes in voting patterns, and support for a given policy is dependent on expected economic conditions. To help unpack these relationships, this section defines income transitions, redistributive schemes and forward-looking demand for redistribution.

2.1. **Stochastic Income Transitions.** Individuals are indexed by i and have an initial income y_{i0}. The initial income distribution F_0 is assumed to be bounded and absolutely continuous. After the initial period 0, individual i's income at time t is

$$(2.1) \qquad y_{it} = \mathrm{E}\left[y_{it}|\mathrm{E}\left[y_{it-1}\right]\right] \cdot \varepsilon_{it}$$

where ε_{it} is iid across individuals and periods with $\mathrm{E}\left[\varepsilon_{it}\right] = 1$. These assumptions imply that the expected income path for any individual is deterministic. To see this, note that since $\mathrm{E}\left[\varepsilon_{it}\right] = 1$, Equation (2.1) implies $\mathrm{E}\left[y_{it}\right] = \mathrm{E}\left[y_{it}|\mathrm{E}\left[y_{it-1}\right]\right]$. Thus if expected income in period $t-1$, $\mathrm{E}\left[y_{it-1}\right]$, is known then $\mathrm{E}\left[y_{it}\right]$ is known. Certainly each individual's initial income y_{i0} is known, which fixes $\mathrm{E}\left[y_{i1}\right] = \mathrm{E}\left[y_{i1}|\mathrm{E}\left[y_{i0}\right]\right]$. This in turn fixes $\mathrm{E}\left[y_{i2}\right] = \mathrm{E}\left[y_{i2}|\mathrm{E}\left[y_{i1}\right]\right]$ and so on. Let f denote the function that maps expected income in period $t-1$ to expected income in period t, formally

$$(2.2) \qquad f \equiv \mathrm{E}\left[y_{it}\right] = f\left(\mathrm{E}\left[y_{it-1}\right]\right). \qquad \text{(Expected Income Transition)}$$

For brevity, we will refer to f as an income transition function. Recursing Equation (2.2) back to an individual's initial income y_{i0} also shows

$$\mathrm{E}\left[y_{it}\right] = f\left(\mathrm{E}\left[y_{it-1}\right]\right) = f\left(f\left(\mathrm{E}\left[y_{it-2}\right]\right)\right) = f^{(2)}\left(\mathrm{E}\left[y_{it-2}\right]\right)$$

and proceeding in this fashion, expected income in period t for a voter with initial income y_{i0} is $\mathrm{E}\left[y_{it}\right] = f^{(t)}(y_{i0})$, while realized income is given by $y_{it} = f^{(t)}(y_{i0}) \cdot \varepsilon_{it}$.

When making decisions about the future, we assume voters care only about present discounted income, discounted at rate δ each period. We can therefore write each voter's discounted income stream over T periods as:

$$(2.3) \qquad \sum_{t=0}^{T} \delta^t y_{it} = \sum_{t=0}^{T} \delta^t f^{(t)}(y_{i0}) \cdot \varepsilon_{it}. \qquad \text{(Discounted Income Stream)}$$

Since $\mathrm{E}\left[\varepsilon_{it}\right] = 1$, expected present discounted income can be read off Equation (2.3) as $\mathrm{E}\left[\sum_{t=0}^{T} \delta^t y_{it}\right] = \sum_{t=0}^{T} \delta^t f^{(t)}(y_{i0})$. We now turn to policies which might redistribute this income.

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2.2. **Myopic Demand for Redistribution.** Consider the political preferences of myopic, pocketbook voters whose incomes evolve according to a known income transition function f as above. Pocketbook voters choose policies which maximize their income, and for simplicity we assume voters are risk neutral. Following Benabou and Ok [2001], we define redistribution schemes composed of a flat tax τ and a lump sum transfer to all voters. Such redistribution schemes are denoted r_τ where if r_τ is enacted in period t, each voter i receives income $r_\tau(y_{it})$:

$$(2.4) \qquad r_\tau(y_{it}) \equiv (1 - \tau) \cdot y_{it} + \tau \cdot (1 - D)\,\mu_t$$

Here μ_t denotes the mean income of the population at time t and $D \in [0,1]$ denotes any dead weight loss under the redistributive scheme. A myopic voter's most preferred policy τ^* must maximize expected income $\mathrm{E}\left[r_\tau(y_{it})\right]$. Since

$$\mathrm{E}\left[r_\tau(y_{it})\right] = (1 - \tau) \cdot \mathrm{E}\left[y_{it}\right] + \tau \cdot (1 - D)\,\mathrm{E}\left[\mu_t\right]$$
$$= (1 - \tau) \cdot f^{(t)}(y_{i0}) + \tau \cdot (1 - D)\,\mu_t$$

either $\tau^* = 1$ (complete redistribution) or $\tau^* = 0$ (laissez-faire).[7]

Now consider a majoritarian vote taken between $\tau = 1$ and $\tau = 0$ at the beginning of period t before idiosyncratic shocks are realized. A myopic voter i prefers $\tau = 1$ to $\tau = 0$ exactly when $\mathrm{E}[y_{it}] = f^{(t)}(y_{i0}) \le (1 - D)\mu_t$, which means they expect to be below average income, less any deadweight loss. Since f in increasing, all voters with initial incomes $y_{i0} \le f^{(-t)}\left((1 - D)\mu_t\right)$ prefer $\tau = 1$ to $\tau = 0$. The fraction of such voters in the population is determined by the initial distribution of income F_0 to arrive at

$$\mathrm{Pr}\left(\text{Voter prefers } \tau = 1\right) = F_0\left(f^{(-t)}\left((1 - D)\,\mu_t\right)\right) \quad \text{(Myopic Demand for Redistribution).}$$

2.3. **Forward-looking Demand for Redistribution.** We now follow Benabou and Ok's framework of forward-looking voters who consider redistributive policies that last from period 0 through period T. Over this time frame, define a voter's discounted income stream under laissez-faire ($\tau = 0$) as $g^T(y_{i0})$. From Equation (2.3), $g^T(y_{i0}) = \sum_{t=0}^{T} \delta^t f^{(t)}(y_{i0})$ and the average of all voters' discounted income streams is therefore $\mu^T \equiv \sum_{t=0}^{T} \delta^t \mu_t$. Complete redistribution ($\tau = 1$) over this period would pay out μ^T, less any deadweight loss, giving a discounted income of $(1 - D)\mu^T$. Consequently, a voter prefers $\tau = 1$ to $\tau = 0$ from periods 0 through T if and only if $g^T(y_{i0}) \le (1 - D)\mu^T$. Akin to the myopic case, the

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[7]This has the implication that if f is known perfectly, voters with the same initial income y_{i0} vote identically. In contrast, the vote could be modeled as taking place after the realization of the shocks ε_{it}, so vote tallies will have an element of randomness which depends on the distribution of ε_{it}.

proportion of voters demanding redistribution is

$$\Pr\left(\text{Voter prefers } \tau = 1\right) = F_0 \left(\left[g^T\right]^{-1} \left((1-D)\,\mu^T\right) \right) \quad \text{(Forward Demand for Redistribution)}.$$

This equation shows that the fraction of the population who wants redistribution takes into account discounting and the evolution of income during the policy. The term $\left[g^T\right]^{-1}\left((1-D)\,\mu^T\right)$ is the forward-looking generalization of the term $f^{(-t)}((1-D)\,\mu_t)$ that determines the demand for redistribution in the myopic voter case. Note that a voter who looks forward only one period (or who considers a policy that will last only one year) has the same preferences as a myopic voter. While initial income distribution, F_0, appears to play a similar role in setting both the myopic and forward-looking demands for redistribution, we shall see later that small perturbations in F_0 can give rise to large changes in forward-looking demand for redistribution, especially for large T. The critical factor is the shape of the underlying income transition function, f. The next section develops a method to explore voter dynamics under any continuous income transition function, a family that is broad enough to encapsulate the processes implied by theories of both convergent and divergent income distribution dynamics.
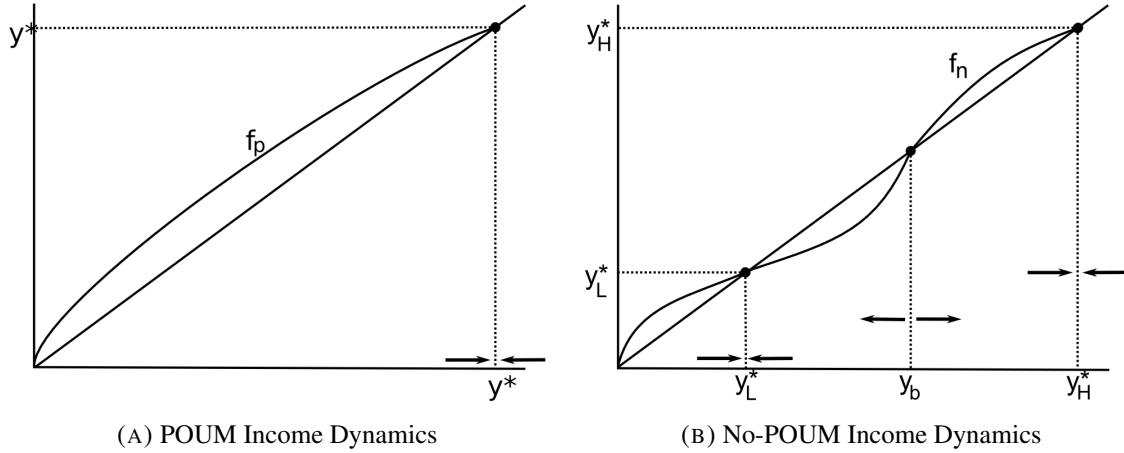
3. POLITICAL EVOLUTION UNDER FULL INFORMATION

The Solow model of neoclassical economic growth relies on an assumption of diminishing capital returns and implies that poorer nations will tend to catch up over time, or converge, with the incomes of richer nations.[8] When transported to the individual or microeconomic level, the Solow assumptions imply a process of convergence among the population of a single country.

Figure 1(a) illustrates a typical income dynamic implied by accumulation under decreasing returns. Note that this concave transition process, maps incomes in period t into incomes in period $t+1$, implies a unique long term or steady state income level, y^*, at the point where $f_p(y)$ crosses the 45-degree line. Under this transition process, individuals who begin with incomes below the steady state level will converge towards it, while those who begin above the steady state level will drop back towards it. Note that this sort of concave income process offers prospects of upward mobility (POUM) to voters whose initial income levels are less than the steady state income level. This Prospect of Upward Mobility for the poor to achieve convergence with the population at large can serve to lessen preferences for redistribution. This mechanism allows Benabou and Ok [2001] to connect POUM income dynamics and *aversion* to redistribution. Subsequent evidence for

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[8]For an early review of both the theoretical and empirical controversies, see Romer [1994]. A more recent review with a theoretical emphasis is Azariadis and Stachurski [2005].

FIGURE 1. POUM and No-POUM Income Transitions

(A) POUM Income Dynamics

(B) No-POUM Income Dynamics

the income-based approach to voting has been mixed, and its reach can be extended by modeling more general income dynamics.[9]

In contrast to Figure 1(a), individuals need not face uniformly decreasing returns in asset accumulation. The increasingly well developed theory of poverty traps suggests a number of mechanisms that can trap households at low living standards (see the review in Carter and Barrett [2006]). Central to all of these theories of poverty traps is exclusion from financial markets.[10] Put differently, if households have access to loan markets and insurance instruments, then even when confronted by locally increasing returns to scale and risk, they can successfully engineer a strategy to obtain the assets needed to jump to a high level equilibrium. But absent access to those financial markets, households below a critical initial asset level may remain stuck in a low level, poverty trap equilibrium.

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[9]Fong [2001] finds that variables reflecting personal benefit from redistribution are insignificant in predicting redistributive preferences in the US. On the other hand, Checchi and Filippin [2004] find some experimental support that the POUM reduces chosen taxation rates and that longer time horizons tend to decrease chosen rates under POUM. Beckman and Zheng [2003] find tentative support for the POUM hypothesis using undergraduate surveys (primarily business and economics majors). At the international level, Wong [2002] examines the GSS and World Values Survey for redistributive preferences and finds the expected signs across incomes, but no evidence of the "tipping behavior" implied by median voter or POUM models. Wong also finds that expected income indicators can help explain redistributive preferences, but are small in magnitude.

[10]There is now a plethora of theory about why financial markets are often thin, missing and, or biased against low wealth agents. Banerjee and Newman [1994] provide an example of a debt based poverty trap which generates income dynamics. For a recent contribution, see Boucher et al. [2007].

The result of such poverty trap models is Figure 1(b) which illustrates income transition dynamics with multiple steady states.[11] The non-concave income transition function, $f_n(y)$, has multiple crossings of the 45-degree line and admits multiple equilibria: y_H^* is the high income steady state; y_L^* is the low level steady state. Bifurcation occurs around the unstable equilibrium income level, y_b. Households with incomes in excess of y_b will tend toward the high level equilibrium while those that begin below this critical threshold will head towards the low level, poverty trap equilibrium, y_L^*. This implies no prospect of upward mobility (No-POUM) for voters below the threshold y_b. In contrast to an economy with a concave income transition function, economic polarization will occur and inequality can deepen when income transitions are governed by a non-concave function like $f_n(y)$.[12]

The remainder of this section considers any continuous income transition function, allowing for both f_p and f_n types of income transitions and then derives a general set of results with political implications. We show that relaxing Benabou and Ok's assumption of concavity can generate rich pattens in the demand for redistribution. We then provide a theorem showing how these new income transitions create both increases and decreases in the demand for redistribution, even when the transition function is neither globally concave nor convex.

3.1. **Demand for Redistribution.** As shown in Section 2, when voters are myopic, the fraction of the population who demand redistribution at time t is given by $F_0(f^{(-t)}((1-D)\mu_t))$. Whether this fraction increases or decreases over time depends on $f^{(-t)}((1-D)\mu_t)$. In a POUM world, the global concavity of f implies (through Jensen's inequality) the relationship $f^{(-t)}((1-D)\mu_t) \geq f^{(-(t+1))}((1-D)\mu_{t+1})$ so the demand for redistribution is always decreasing over time.

Similarly, if voters are forward-looking, the fraction of the population that wants redistribution $F_0([g^T]^{-1}((1-D)\mu^T))$ monotonically decreases as the duration of a policy increases.[13] Therefore in a POUM world with forward-looking voters, the demand for redistribution decreases with time in two senses: as evaluations each single period and as policy longevity increases. This is the type of behavior that Benabou and Ok set out to explain. These two salient aspects of redistributive dynamics in a POUM world can be summarized as

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[11]For empirical examples see Lybbert et al. [2004] and Adato et al. [2006]. Banerjee and Newman [2000] construct a macroeconomic model of "dynamic institutional change" which implies non-concave income dynamics and exhibits path dependence on the distribution of wealth.
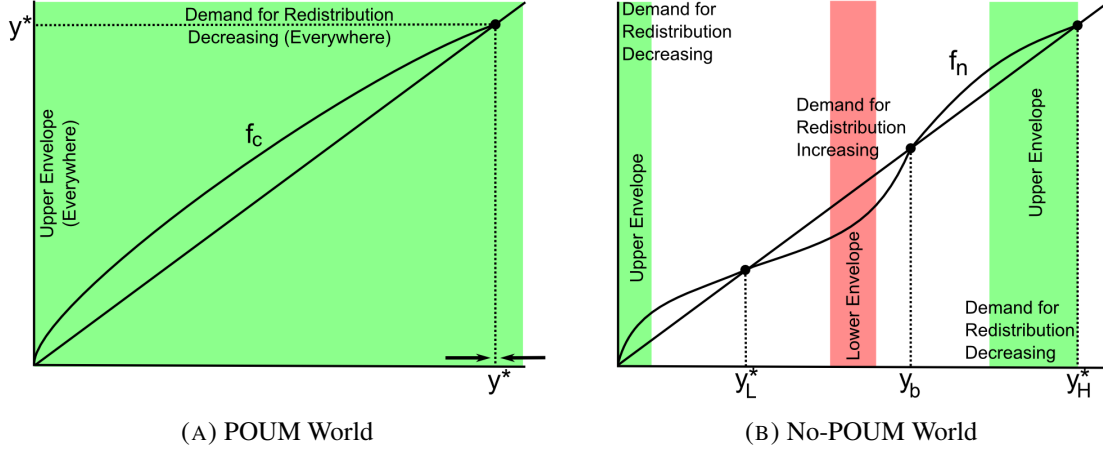
[12]Strictly speaking, this non-concave income transition function implies increasing polarization, not necessarily increasing inequality, as Esteban and Ray [1994] discuss.

[13]These statements follow respectively from Proposition 2 and Theorem 3 of Benabou and Ok [2001].

Proposition (POUM Dynamics). *Suppose f is concave. Then:*

(1) *The demand for a single period of redistribution decreases over time.*

(2) *The demand for redistribution over a T period horizon decreases in T.*

FIGURE 2. Upper and Lower Envelopes

(A) POUM World

(B) No-POUM World

While voter dynamics under POUM are relatively straightforward, non-convexities under general income transitions lead to more complex redistributive dynamics. To better describe this complex process, we connect the changing demand for redistribution to the upper and lower envelopes of an income dynamic. We first define the upper envelope of f, $\overline{f}$, as the envelope created by tracing all lines which are above, but do not cross f. The lower envelope $\underline{f}$ is defined similarly. Both types of envelopes are illustrated in Figure 2(b) and defined in Equation (3.1).

$$(3.1) \qquad \overline{f} \equiv \inf\{h(x): h \text{ is a line}, h \geq f\}, \quad \underline{f} \equiv \sup\{h(x): h \text{ is a line}, f \geq h\}.$$

Clearly for each y we have $\overline{f}(y) \geq f(y) \geq \underline{f}(y)$ and necessarily $\overline{f}$ is concave and $\underline{f}$ is convex. Two special cases stand out. When f is concave, $\overline{f}$ and f coincide. When f is convex, $\underline{f}$ and f coincide. Therefore in a POUM world, $f = \overline{f}$. We define the sets of incomes where f and $\overline{f}$ exactly coincide as Y_P (as this is the domain of upward mobility). Similarly define the domain of downward mobility, Y_N, as incomes where f and $\underline{f}$ coincide. The relationship of Y_P and Y_N to the path of redistributive preferences is given in Proposition 1:

Proposition 1. *If $\mu_t \in Y_P$ then the demand for redistribution decreases in period t relative to period $t-1$. Conversely, if $\mu_t \in Y_N$ then the demand for redistribution increases.*

Proof. We consider $\mu_t \in Y_{\mathrm{P}}$ as the other case is similar. We want to show that $f^{(-t)}(\mu_t) \geq f^{(-(t+1))}(\mu_{t+1})$. This holds iff $\mu_{t+1} \leq f(\mu_t)$ and by assumption $f(\mu_t) = \overline{f}(\mu_t)$. Therefore we are done if we can show $\mu_{t+1} = \int f^{(t+1)}dF_0 \leq \overline{f}(\mu_t)$. Since $f \leq \overline{f}$ we know that $\int f^{(t+1)}dF_0 \leq \int \overline{f} \circ f^{(t)}dF_0$ so we need to show $\int \overline{f} \circ f^{(t)}dF_0 \leq \overline{f}(\mu_t)$. In fact, this last inequality holds by Jensen's inequality since by construction, $\overline{f}$ is concave. $\square$

Proposition 1 says that if the mean income next period μ_t lies in Y_{P}, the demand for redistribution *decreases*. Conversely, if μ_t lies in Y_{N}, the demand for redistribution *increases*. In this sense, the upper and lower envelopes of f are natural definitions of Right and Left income transitions based on f. This also highlights the differences between POUM and No-POUM income dynamics. In a POUM world, f is concave and equals $\overline{f}$ so all incomes (including μ_t) are in Y_{P}. Therefore the demand for redistribution is always decreasing (Figure 2a). In contrast, a No-POUM income dynamic has both Y_{P} and Y_{N} regions. Depending on where μ_t lies the next period, the demand for redistribution can either increase or decrease (Figure 2b).

In a No-POUM world, the determination of whether the demand for redistribution is increasing or decreasing depends simultaneously on the current period, the expected income transition and the initial distribution of income. Although the demand for redistribution may be directly computed, in general it is hard to derive a particular path analytically due to its dependence on the range of possible income distributions. In the appendix, we illustrate this point with a concrete example where small changes in F_0 cause qualitative changes in the demand for redistribution over time. The appendix also shows that for a large class of income dynamics, whether the demand for redistribution is increasing or decreasing depends heavily on the initial distribution of income. In the next section we apply these insights about curvature to actual income dynamics in Latin America.

4. DEMAND FOR REDISTRIBUTION IN LATIN AMERICA

The prior section has shown that political dynamics for forward looking voters will depend on both the income transition and the initial distribution of income. This section asks if these two considerations can help us understand recent electoral dynamics in Latin America. Building on the method of Shorrocks and Wan [2008], we first recover income distributions for several periods, and then use these to calibrate income transition functions as the basis for the analysis of political dynamics in Chile and Peru.

4.1. **Income Distribution Dynamics in Chile and Peru.** The analysis here relies on income decile data from SEDLAC (CEDLAS and The World Bank, 2011). We first use

this data to to construct approximate income distributions $\{\hat{F}_t\}$ for each period by fitting a monotone spline to recover each distribution.[14] In order to recover income dynamics $\hat{f}(y)$, we consider all functions which are composed of line segments spanning each income decile. Letting β denote a vector of ten line slopes (one for each decile), we can write every admissible income dynamic $\hat{f}(y)$ as $f_\beta(y)$ for some β. To calibrate $f_\beta(y)$, we make use of the identity that if $F_t(y)$ is the distribution of expected incomes $\mathrm{E}[y_{it}]$, then

(4.1)
$$f^{(t)}(y) = F_t^{-1} \circ F_0(y)$$

which fixes the relationship between the annual distribution of income $F_t(y)$ and the true income dynamic $f(y)$.[15] Equation (4.1) combined with estimates of the income distribution each period, say $\{\hat{F}_t\}$, provides a basis to calibrate $f_\beta(y)$ since Equation (4.1) implies $f_\beta^{(t)}(y) \approx \hat{F}_t^{-1} \circ \hat{F}_0(y)$ for each observed period t.[16]

Using these relationships, we then fit $f_\beta(y)$ to best explain the recovered income distributions for each observed year, $\{\hat{F}_t\}$. To do this, we assume $\hat{F}_t^{-1} \circ \hat{F}_0(y) = f_\beta^{(t)}(y) \cdot \varepsilon(y)$ with the error term $\varepsilon(y)$ distributed lognormal $(0, \sigma)$. This implies that for each y, $\hat{F}_t^{-1} \circ \hat{F}_0(y)$ is distributed lognormal $\left(f_\beta^{(t)}(y), \sigma \right)$. Taking our cue from maximum likelihood estimation, let $\phi(y, \mu, \sigma)$ denote the lognormal likelihood for an observation y. We then maximize the log likelihood summed across all years and incomes by finding β and σ to solve Equation (4.2):

(4.2)
$$\max_{\beta, \sigma} \sum_{t \text{ observed}} \int \ln \phi \left(y, f_\beta^{(t)}(y), \sigma \right) dF_0(y).$$

Further numerical details are given in the appendix below.

Having calibrated $f_\beta(y)$ to recover income dynamics $\hat{f}(y)$ for Chile and Peru, we present the results graphically in Figure 3. A benchmark of ten years is illustrated as this roughly corresponds to two presidential election cycles in Latin American countries. Thus Figure 3 shows the calibrated income dynamic over ten years $(\hat{f}^{(10)})$ for each country. The vertical lines lines in the graphs represent rough boundaries between income decile ranges As can

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[14]The SEDLAC income measures include monetary, non-monetary and transfer income in addition to imputed rent, and we use the following country-year pairs: Chile (1994, 1996, 1998, 2000, 2003, 2006) and Peru (1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006).

[15]To see this identity, note that by definition, $F_t(y) = \Pr(y_{it} \leq y)$ and since $y_{it} = f^{(t)}(y_{i0})$ we have
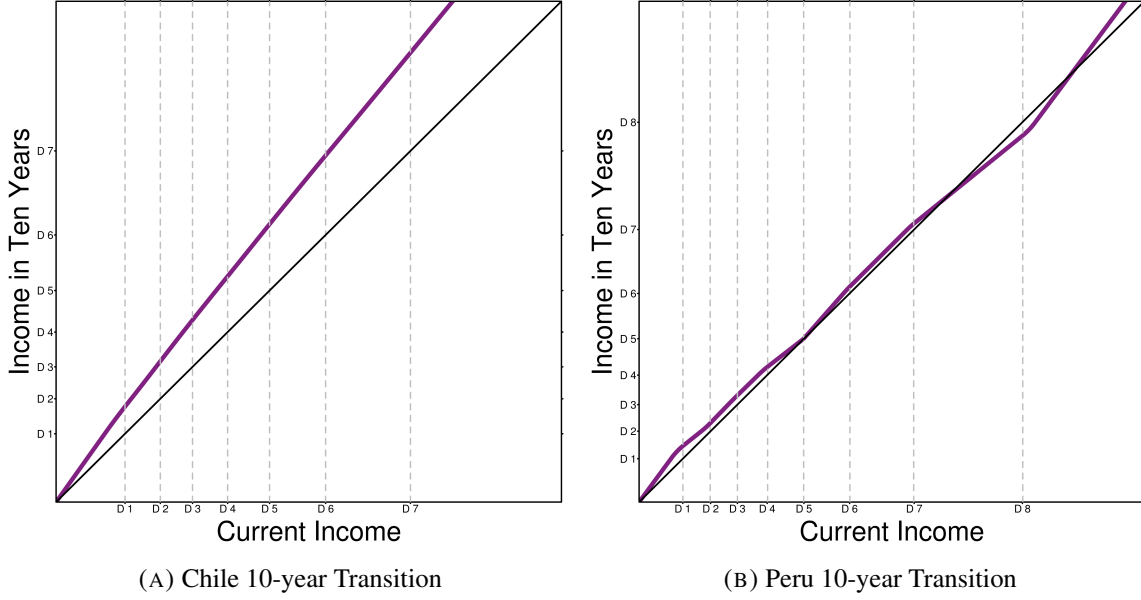
$$F_t(y) = \Pr(y_{it} \leq y) = \Pr\left(f^{(t)}(y_{i0}) \leq y \right) = \Pr\left(y_{i0} \leq f^{(-t)}(y) \right) = F_0\left(f^{(-t)}(y) \right).$$

It follows that $F_0^{-1} \circ F_t(y) = f^{(-t)}(y)$ and finally by inverting both sides that $f^{(t)}(y) = F_t^{-1} \circ F_0(y)$.

[16]This is similar to Shorrocks and Wan [2008] who use a parametric approach to back out income distributions from income decile data. By comparing synthetic income distributions generated by their method with known distributions, these authors find this method to have surprising accuracy.

be seen, the income dynamics for Peru show areas of convexity for much of the income distribution and therefore exhibit No-POUM dynamics. In contrast, the income dynamics for Chile show at least some prospects for absolute, if not relative, mobility for all deciles of the income distribution.

FIGURE 3. Calibrated Income Transition Functions

(A) Chile 10-year Transition   (B) Peru 10-year Transition

4.2. **Predicted Political Dynamics Under Full Information.** Using the recovered income transition functions for Peru and Chile, we now derive the electoral dynamics implied by our model of voters who possess full information on the underlying income transition process. We consider the historical time period covered by our income decile data (mid-1990s to the mid-2000s) and consider policy longevities (degrees of forward-lookingness) of 1 to 10 years. We assume that redistribution incurs no dead weight loss ($D = 0$) and voters have a discount rate of $\delta = .95$. Computing the demand for redistribution across time and for varying policy lengths then follows the development above. At any point in historical time, H, and for any degree of policy longevity, T, we calculate the fraction of the electorate supporting different policies as implied by our model:
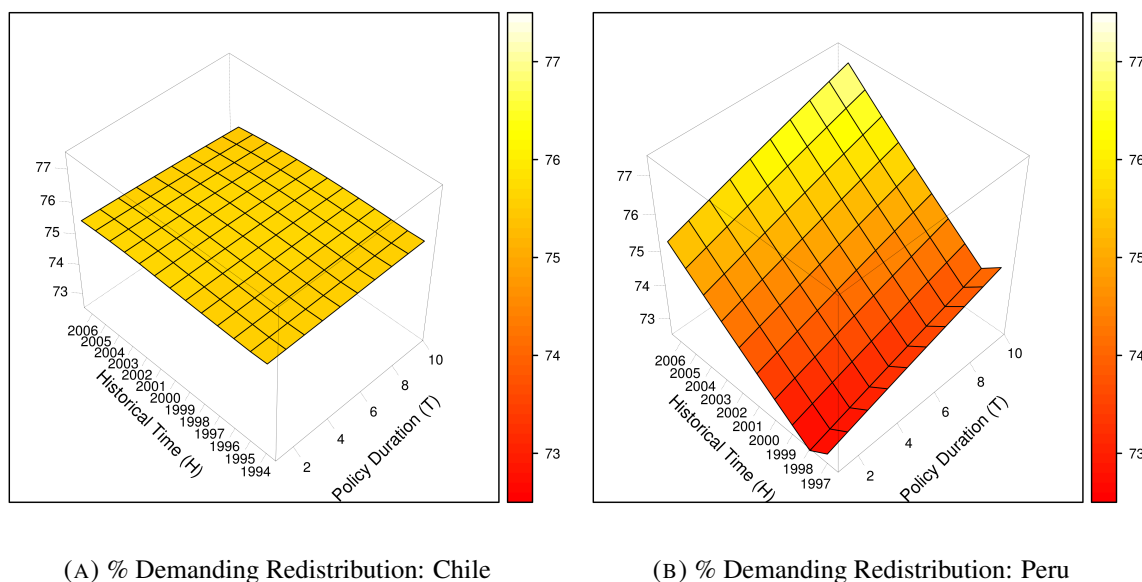
$$\Pr\left(\text{Voter prefers } \tau = 1\right) = \tilde{F}_H\left(\left[\hat{g}^T\right]^{-1}\left(\hat{\mu}^T\right)\right) \quad \text{(Forward Demand for Redistribution)}$$

where $\hat{g}^T(y_{i0}) \equiv \sum_{t=0}^{T} \delta^t \hat{f}^{(t)}(y_{i0})$, $\hat{\mu}^T \equiv \mathrm{E}\left[\hat{g}^T(y_{i0})\right]$ and $\tilde{F}_H(y) \equiv \hat{F}_0 \circ \hat{f}^{(-H)}(y)$.

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Figure 4 graphs the results of these calculations for Chile and Peru under the assumptions that redistribution incurs no dead weight loss ($D = 0$) and that $\delta = .95$. First, consider the myopic ($T = 1$) demand for redistribution in each country. Over time, Chile shows a fairly linear pattern in Figure 3(a), which implies fairly flat redistributive preferences over the period as calculated in Figure 4(a). In contrast, reflecting the non-concavities in its estimated income dynamics, Peru shows a pattern in which the myopic demand for redistribution increases over time.

Figure 4 also allows us to see what happens over time when voters are forward-looking (and as policy longevity increases). In the case of Chile, more forward-looking voters and longer-lasting policies barely perturbs the demand for redistribution at any point in time. Peru again presents an interesting picture as more forward-looking voters support redistribution more strongly than do myopic voters, increasingly so over historical time.

FIGURE 4. Evolving Demand for Redistribution

(A) % Demanding Redistribution: Chile

(B) % Demanding Redistribution: Peru

While the contrast between Chile and Peru illustrates the importance of income transition dynamics for political dynamics, the calculated level of support for redistribution is remarkable high for both countries, in all time periods and under any degree of forward-lookingness. Put differently, the full information voter model predicts that there would have been strong support for redistributive policies long before such support actually emerged. While there are many possible explanations for the tardy arrival of support for more aggressively redistributive policies, one is that voters perceived significant dead weight losses to

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redistribution. To explore this idea, we calculate the level of dead weight taxation loss that would have been necessary to provide majoritarian support for non-redistributive, laissez faire policies in Chile and Peru under the assumptions used to generate Figure 4. These levels are 45-48% in Chile and 43-47% in Peru. These levels are exceedingly high in comparison to existing estimates of dead weight loss (See for instance Olken [2006]), making it unlikely that dead weight losses explain the mismatch between model prediction and reality.

5. LEARNING AND VOTING UNDER IMPERFECT INFORMATION

While the analysis so far is consistent with the left turn that took place in Latin America politics, it cannot account for the timing of that shift, throwing into sharp relief the question as to why so many voted for largely laissez faire policies prior to the early part of this century. The answer cannot be found in the prospect of upward mobility as our recovered income transitions suggest that there were not prospects of upward mobility for important segments of the electorate. Indeed, forward-looking pocketbook voters with perfect information on the nature of income dynamics would have supported redistributive policies sooner and more forcefully than they actually did.[17]

In reality of course, perfect information is unlikely as income dynamics and the prospects for mobility are complex and hard to understand, especially in transition economies, which had fundamentally altered their economic model. Our analysis so far has followed Benabou and Ok and assumed that voters know the true income transition function and use this knowledge to construct their forward looking income forecasts and vote accordingly. We now relax this assumption and consider the behavior of voters who must learn about the the true income dynamics from their own experience.

To keep this problem manageable, we assume voters face a known family of possible expected income transition functions $f_\lambda(y)$ indexed by the parameter λ. The family of expected income transitions is assumed to be bracketed by two extreme specifications, one representing a right perspective or vision of how the economy operates ($\lambda = 1$) and the other a left perspective ($\lambda = 0$). We refer to these specifications as "ideologies," using this word to denote a model or understanding of how the world works. We assume that any income transition function that voters consider can be expressed as a linear combination of

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[17]It is of course possible that people are fooled, or fool themselves, about the nature of income dynamics and vote against their true economic interests. Survey research which assesses voter's subjective expectations about prospects has found "POUM captures hopes and expectations as well as realistic socioeconomic assessments" [Graham and Pettinato, 2002]. Additional possibilities are considered by Putterman [1996]. A careful study of how economic information is mediated by larger sets of social relations is Herrera [2005] in the context of post-USSR Russia.

the left (f_L) and the right (f_R) ideologies:

$$(5.1) \qquad\qquad f_\lambda(y) = (1 - \lambda)f_L(y) + \lambda f_R(y)$$

At any point in time t, the individual's understanding of the economy can be represented by a probability density $\pi_{it}(\lambda)$ over possible values of λ while the true value of λ, labeled λ_0, is unknown to voters. Note that this specification naturally describes someone with a left view of the world as putting a lot of probability weight on low or left values of λ, whereas a right view of the world would have probability weight near the right side of the spectrum or 1. We normalize the true value of state of the world λ_0 to be $1/2$. This specification of how voters predict their future income under incomplete information will be incorporated into our model of forward-looking voters.[18] However, we first consider how the critical new element, the voter's probability distribution $\pi_{it}(\lambda)$, is formed and evolves over time.

Each voter i begins with a prior distribution $\pi_{i0}(\lambda)$ over possible values of λ. We also assume that voters keep track of their idiosyncratic income histories $H_{it} \equiv \{y_{i0}, \ldots, y_{it}\}$. The history H_{it} is used to update beliefs each period to a posterior belief $\pi_{it}(\lambda|H_{it})$ according to Bayes rule. In our context, we can think of $\pi_{i0}(\lambda)$ as the initial ideological beliefs a voter has about the income transitions they face, while $\pi_{it}(\lambda|H_{it})$ are the voter's new ideological beliefs after t periods of learning the true income dynamic.

In order to make this learning process concrete, we now analyze it assuming an explicit structure of the transient income shocks and their relationship to income each period in Assumption 1.

Assumption 1. *The income dynamic each voter faces satisfies the following:*

   (1) *The true state of the world is normalized to $\lambda_0 = 1/2$.*
   (2) *The shock ε_{it} is distributed $Uniform(1 - \sigma, 1 + \sigma)$ for some $\sigma \in (0, 1)$.*
   (3) *Voters know the value of σ.*

Under Assumption 1, $y_{it} = f_{1/2}^{(t)}(y_{i0}) \cdot \varepsilon_{it}$ so voters receive some random fraction, ε_{it}, of their true expected income given $\lambda_0 = 1/2$. The magnitude of σ determines whether fluctuations around the expected value are large or small, with a larger σ obscuring the true income dynamic from voters.

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[18]Note that this specification could be extended to incorporate the possibility that repression or fear constricts the political space, leading people to vote, say, more conservatively than they otherwise might. For instance, voters may fear possible retribution for revealing their ideological "type" because of potential political policing (e.g. a potential return to dictatorship in early 1990's Chile). In this case, one could model the ideological space as being constrained in an ideological spectrum of $[\underline{\lambda}_t, \overline{\lambda}_t]$ which expands with "political thawing" and voter faith in democratic institutions over time. The gradual expansion of publicly admissible views may also help explain large shifts.

Now consider how voters update their beliefs under Assumption 1. Since for any true state of the world λ, $\varepsilon_{it} = y_{it}/f_{\lambda}^{(t)}(y_{i0})$ and each voter knows that $|\varepsilon_{it} - 1| \leq \sigma$, voters know

(5.2)
$$\left| y_{it} // f_{\lambda}^{(t)}(y_{i0}) - 1 \right| \leq \sigma.$$

Equation (5.2) encapsulates the fact that a voter knows that realized income y_{it} must be within a fraction σ of expected income $f_{\lambda}^{(t)}(y_{i0})$. Therefore any state λ for which Equation (5.2) fails to hold cannot correspond to the true income dynamic. Eliminating these impossible states is exactly what Bayes rule dictates as the updating rule. Accordingly, $\pi_{it}(\lambda|H_{it})$ is exactly $\pi_{i0}(\lambda)$ restricted to all values of λ that satisfy Equation (5.2) for the voter's entire history H_{it}, then normalized to integrate to one.[19]

Appendix C develops the mechanics of the learning dynamics in more detail. These assumptions (and associated analytics) imply that voting behavior under imperfect information is determined by each voter's beliefs given their income history ($\pi_{it}(\lambda|H_{it})$) and the expected redistributive transfer for each possible state of the world λ. A myopic pocketbook voter (looking forward only one period) will vote in favor of redistribution in period t when the voter *believes* expected transfers are positive:

$$\int_0^1 \underbrace{\left[(1-D)\int f_{\lambda}^{(t+1)}(y)dF_0(y) - f_{\lambda}^{(t+1)}(y_{i0}) \right]}_{\text{Expected Transfer}|\lambda, y_{i0}} \cdot \underbrace{\left[\pi_{it}(\lambda|H_{it}) \right]}_{\text{Beliefs}|H_{it}} d\lambda \geq 0.$$

This expression naturally generalizes to the case when policies persist and voters look forward by more than one period. As this expression makes clear, evolving voter beliefs inserts another dynamic element into the determination of political preferences. The next section will explore whether the forward-looking voter model, augmented with Bayesian learning effects, can better explain contemporary Latin American political dynamics.

6. THE RIGHT LEFT POLITICAL SHIFT IN IN LATIN AMERICA

This section employs the model of forward-looking, Bayesian voters to analyze the right to left political shift observed across contemporary Latin America. To do this, we first provide an empirically grounded approach for representing left and right political ideologies. Second, we argue that economic crises of the 1980s put the left in disarray, and at the time of the market transitions voters adopted a POUM prior as the economic crises of the 1980s left no credible alternative to the emergent neoliberal model. Applying these assumptions

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[19]The assumption that $\varepsilon_{it} \sim$ Uniform guarantees a clean updating rule which reduces the computational burden for applications. Other shock distributions are similar in character but will induce updating rules that include weights from ε_{it} for each voter history that substantially increase computational dimensionality.

to Peru, we show that voter learning over the course of a dozen years would be expected to generate up to a 27 percentage point shift in the electorate towards preferring redistributive to free market policies, with those preferring redistribution moving from a minority to a majority of the population.

6.1. **Empirical Approximation of Left and Right Ideologies.** In order to arrive at plausible left and right ideological models of income dynamics, we construct two functions (f_R and f_L) that surround and exaggerate the true empirical income transition function, $\hat{f}(y)$. We begin by characterizing the right income transition model as one that offers greater prospects for upward mobility and implies less demand for redistribution than does $\hat{f}$. For a given f_R, we then residually construct f_L so that the true function can be expressed as a linear combination of the left and right ideologies as specified in Equation (5.1) above.

We keep our modeling options fairly open by defining f_R using a continuum of transition functions $f_\rho(y)$ indexed by the parameter ρ. Successively higher values of ρ correspond to more exaggerated right ideologies that promise greater upward mobility and imply less demand for redistribution. Given our method for residually calculating the left ideology, higher values of ρ also imply greater ideological polarization in the sense that the left and right positions become more sharply differentiated. Our characterization of any such continuum of $f_\rho(y)$ relies on the following partial converse of Jensen's Inequality, proved in the appendix.

Lemma. *Suppose f and g are continuous where g is defined on $f((-\infty, \infty))$. Then g is concave iff $g(\mathrm{E}[f(X)]) \geq \mathrm{E}[g(f(X))]$ for all bounded random variables X.*

This result shows in particular that if g is continuous and $g(\mathrm{E}[X]) \geq \mathrm{E}[g(X)]$ for all bounded random variables X, then g is concave. The Lemma helps provide a sharp characterization about which members of a family of income transitions are more ideologically "Right" in that they induce lower demand for redistribution, as given in Proposition 2.

Proposition 2. *Let $f_\rho(y)$ be a set of income transitions indexed by ρ. Assume each $f_\rho(y)$ is strictly increasing and twice continuously differentiable. Then demand for redistribution decreases in ρ for all income distributions if and only if $\frac{\partial}{\partial y} \ln \frac{\partial}{\partial y} f_\rho(y)$ decreases in ρ.*

Proof. We want to show that for all $\Delta > 0$

$$(6.1) \qquad f_\rho^{-1}\left(\int f_\rho dF\right) \geq f_{\rho+\Delta}^{-1}\left(\int f_{\rho+\Delta} dF\right)$$

for all bounded distributions F, iff $\frac{\partial}{\partial x} \ln \frac{\partial}{\partial x} f_\rho(x)$ decreases in ρ. Let h be defined by $h \equiv f_{\rho+\Delta} \circ f_\rho^{-1}$, and since $f_{\rho+\Delta}$ is strictly increasing, Equation (6.1) is equivalent to

$h\left(\int f_\rho dF\right) \geq \int h \circ f_\rho dF$. It therefore follows from the Lemma above that Equation (6.1) holds for all F iff h is concave. Direct inspection shows

$$(6.2) \qquad h'' = f''_{\rho+\Delta} \circ f_\rho^{-1} / \left(f'_\rho \circ f_\rho^{-1}\right)^2 - f'_{\rho+\Delta} \circ f_\rho^{-1} \cdot f''_\rho \circ f_\rho^{-1} / \left(f'_\rho \circ f_\rho^{-1}\right)^3.$$

Therefore h'' exists and is continuous by inspection. We conclude h is concave iff $h'' \leq 0$. Equation (6.2) shows $h'' \leq 0$ iff $f''_\rho / f'_\rho \geq f''_{\rho+\Delta} / f'_{\rho+\Delta}$, i.e. $\frac{\partial}{\partial y} \ln \frac{\partial}{\partial y} f_\rho(y)$ decreases in ρ. $\qquad \square$

We now describe the construction of f_R and f_L from the empirical income transition $\hat{f}(y)$. First define $\overline{f}(y)$, the upper envelope of $\hat{f}(y)$ (which is necessarily concave, thereby inducing POUM dynamics). Now consider the income transition $C(y) \equiv \overline{f}(y) - \overline{g} \cdot y$ where $\overline{g} \equiv E\left[\overline{f}(y)\right] / E[y]$. $C(y)$ has the same curvature as $\overline{f}(y)$ since $C''(y) = \overline{f}''(y)$, yet implies no change in mean income as $E[C(y)] = E\left[\overline{f}(y)\right] - E[\overline{g} \cdot y] = 0$. We conceptualize the "Right Ideology" $f_R(y)$ by adding a multiple of $C(y)$ to the empirical income transition $f(y)$ and subtracting the same multiple from $f(y)$ to arrive at the "Left Ideology" $f_L(y)$. We denote the constant that multiples $C(y)$ by ρ, giving the following expressions for $f_R(y)$ and $f_L(y)$:

$$(6.3) \qquad f_R(y) \equiv f(y) + \rho\left[\overline{f}(y) - \overline{g} \cdot y\right], \quad f_L(y) \equiv f(y) - \rho\left[\overline{f}(y) - \overline{g} \cdot y\right].$$

Increases in the constant ρ generally decrease the demand for redistribution under $f_R(y)$, in line with the intuition that as ρ increases, more of the curvature from $\overline{f}(y)$ is present in f_R. To illustrate this formally, note that for moderately large ρ, $f_R(y) \approx \overline{f}(y) + \rho\left[\overline{f}(y) - \overline{g} \cdot y\right]$ so appealing to Proposition 2 we see

$$\frac{\partial}{\partial \rho} \frac{\partial}{\partial y} \ln \frac{\partial}{\partial y} f_R(y) \approx \frac{\partial}{\partial \rho} \frac{\partial}{\partial y} \ln \frac{\partial}{\partial y} \left(\overline{f}(y) + \rho\left[\overline{f}(y) - \overline{g} \cdot y\right]\right)$$

$$= \left\{\overline{f}''(y)\overline{g}\right\} / \left(\overline{f}'(y) + \rho[\overline{f}'(y) - \overline{g}]\right)^2 < 0.$$
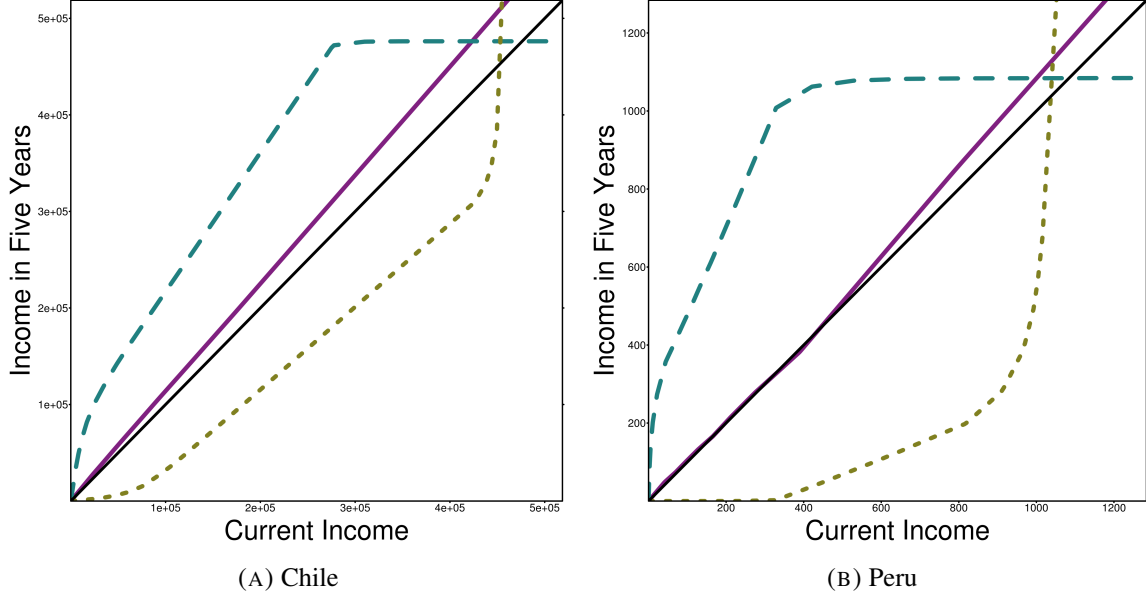
Therefore our definition of f_R implies lower demand for redistribution as ρ increases; a higher ρ implies a more powerful POUM effect under f_R.[20]

Figure 5 illustrates the application of this approach of constructing $f_R(y)$ and $f_L(y)$ in Chile and Peru. The uppermost curve is $f_R(y)$, representing the effect of adding the curvature term $\rho \cdot C(y)$ to $f(y)$, while the bottom curve is $f_L(y)$ with the same term $\rho \cdot C(y)$ subtracted from $f(y)$. Referring back to Equation (6.3), the parameter ρ determines the spectrum of possible income transitions between $f_R(y)$ and $f_L(y)$ by making both of these bounding transitions more extreme. Using the empirical income transition functions of Figure 3, we fix the constant ρ to be the large as possible to capture the widest range

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[20]Alternatively, one may *define* $f_R(y) \equiv \overline{f}(y) + \rho\left[\overline{f}(y) - \overline{g} \cdot y\right]$ to arrive at this result analytically (i.e. without approximation). This makes no numerical difference in practice, but burdens the subsequent notation.

of possibilities, subject to the constraint that both $f_R(y)$ and $f_L(y)$ are increasing. These maximal values of ρ are 28.4 (Chile) and 43.2 (Peru).

FIGURE 5. Stylized Right and Left Income Ideologies

(A) Chile   (B) Peru

6.2. **Learning and Political Dynamics under a 'TINA' Prior.** The final element needed to permit analysis of Latin American political dynamics is a specification of voters' initial beliefs about income dynamics and the prospects for upward mobility at the beginning of the 1990s. To illustrate the implications of our model, we take seriously the then common observation that there was an exhaustion of credible political alternatives to a liberal economic regime. As Margaret Thatcher famously intoned: "TINA–There Is No Alternative" to free markets (Margaret Thatcher Foundation, 1984-85). Thatcher's statements motivate what we call the TINA or POUM prior, meaning an initial set of beliefs, $\pi_{i0}(\lambda)$, that heavily weight the right perspective on the income process and its promise of upward mobility. In the numerical analysis that follows, we use a simple prior form which places exponential weight on Right beliefs for voters in the initial period, namely $\pi_{i0}(\lambda) = 10e^{10\lambda}/(e^{10} - 1)$. Although this is one particular prior, the results are fairly robust to any prior highly weighted to the Right ideology.

With the TINA prior in hand, and the empirically grounded representations of Left and Right ideologies in Figure 5, we are now in a position to numerically simulate political dynamics in Chile and Peru. For the simulations, we assume that income process is noisy with an idiosyncratic income shock parameter $\sigma = 1/2$, and that voters look forward ten years

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and have a discount rate of 95%. Figure 6 shows the simulated evolution of political preferences for Peru in the initial period, six years later and twelve years later. The *y*-axis shows the percentage of the electorate preferring redistribution by income percentile. The solid line in each figure is the full information benchmark, showing what political preferences would have looked like had voters had perfect information on the true income dynamic. The dashed line shows political preferences by decile under imperfect information (and when voters begin with the TINA prior) and when there are no deadweight losses associated with redistribution. The dotted line shows the same imperfect information scenario but assumes that redistribution is associated with a 10% deadweight loss.

As can be seen, the preferences of fully and imperfectly informed voters are quite different, although absent any deadweight loss the median voter would have preferred redistribution from the outset. However, with a 10% deadweight loss, the median, forward-looking voter would have initially voted against redistribution under the TINA prior. However, after six years of living and learning from the actual income distribution process, the median voter, and most voters in the lowest seven deciles of the income distribution would have favored redistributive policies. After a dozen years, the preferences of most voters approach those that would hold under full information, implying a major political shift from minority to majority support for redistribution.

FIGURE 6. Demand for a 10 Year Redistributive Policy by Income Percentile

(A) Peru: Year 0   (B) Peru: Year 6   (C) Peru: Year 12
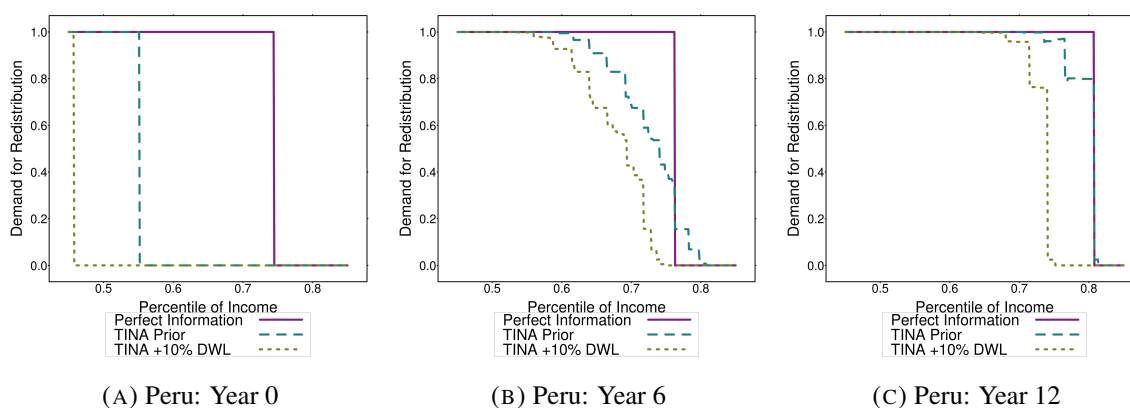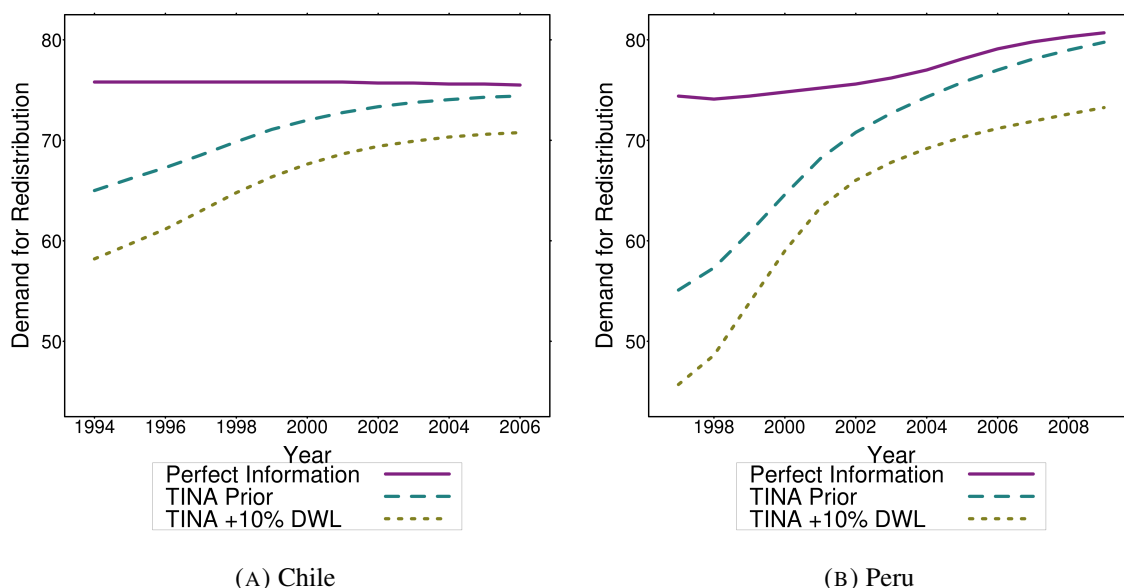
Figure 7 provides another look at the political dynamics implied by our model of forward-looking, Bayesian voters. The vertical axis now displays the fraction of the electorate at each point in time that is expected to vote for redistribution. Absent dead weight losses, over the 1997 to 2009 simulation period in Peru, the fraction voting for redistribution rises by some 22 percentage points, again approaching the levels that would be expected under

full information by 2010. With deadweight losses, politics become even more volatile with a 27% shift over the 12-year simulation period.

These sharp swings in policy preferences are largely driven by swing voters' reevaluation of their prospects for upward mobility as they learn from the actual operation of the Peruvian economy.[21] An interesting contrast to these results is provided by undertaking a similar exercise for the Chilean economy. The estimated Chilean income transition function of Figure 5(a) is one that shows absolute upward income mobility for all classes, though not much relative improvement for the initially lower income deciles. While simulated preferences for redistribution in the Chilean case are strong, they remain quite stable over time, offering a vision of much more stable politics in Chile than in a country with a polarizing income distribution process.

FIGURE 7. Aggregate Demand for a 10 Year Redistributive Policy

(A) Chile

(B) Peru

6.3. **Dead Weight Loss and Political Volatility.** In the voter simulations just discussed, deadweight losses increase political volatility, quite substantially in the Peruvian case. At first glance, this result seems somewhat surprising as one might think that deadweight losses would uniformly depress the demand for redistribution, but would have no effect on its volatility. But, as this section explains, this volatility effect is systematic and explained by the asymmetric effect that D has on a Right partisan with a strong belief in f_R

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[21]Recall from Section 4 that under full information, the mere passage of time led to only a tiny change in the faction of the electorate preferring redistribution.

in comparison to a Left partisan with a strong belief in f_L. Increases in D attrit support for redistribution much faster for a Right partisan than for a Left partisan, creating a wider gulf to cross as voters learn. As individuals learn and their beliefs move away from f_R, their sensitivity to dead weight losses evaporates, further powering a large shift in the population's support for redistributive policies.

In order to formalize this idea, let $\widetilde{y}_R$ denote the income level of a voter who is indifferent about a single period of redistribution under f_R, and similarly let $\widetilde{y}_L$ denote the income of a voter who is indifferent under f_L.[22] By definition, the fraction of voters preferring redistribution under f_L is $F_0(\widetilde{y}_L)$ while under f_R the fraction is $F_0(\widetilde{y}_R)$. The gap between these two fractions, $F_0(\widetilde{y}_L) - F_0(\widetilde{y}_R)$, is completely accounted for by the range of possible beliefs held by voters, and will manifest in voting behavior whenever the beliefs of the population undergo systematic change. This gap quantifies potential political volatility, and surprisingly, increases in deadweight loss D increase the magnitude of $F_0(\widetilde{y}_L) - F_0(\widetilde{y}_R)$. Under plausible assumptions, $\partial[F_0(\widetilde{y}_L) - F_0(\widetilde{y}_R)]/\partial D > 0$. Direct manipulation show this inequality is equivalent to Equation (6.4) below, which we will verify step-by-step below while detailing our assumptions.

(6.4) $$\left(F_0'(\widetilde{y}_L)/F_0'(\widetilde{y}_R)\right) \cdot \left(\mathrm{E}[f_L]/\mathrm{E}[f_R]\right) < \left(f_L'(\widetilde{y}_L)/f_R'(\widetilde{y}_R)\right)$$

Our first assumption regards the properties of the income distribution. It is a stylized fact of real world income distributions that the mean is below the median. A similar observation is that most real world income distributions are unimodal, and that the mode typically occurs within the bottom 25% of the distribution. It follows that voters at or below this unique mode would always vote for redistribution, even allowing for substantial deadweight loss of redistribution. These observations are stated as Assumption 2.

Assumption 2. *Voters at the unique mode of the income distribution (which, as a stylized fact, is far below the mean) always prefer redistribution.*

Our second assumption is basically that the income transitions f_R and f_L deserve the labels of Right and Left, in that f_L implies greater demand for redistribution than f_R, i.e. $F_0(\widetilde{y}_L) > F_0(\widetilde{y}_R)$. This assumption may be satisfied in many ways, not least through our specific construction or more generally by constructing a continuum of Right-Left income transitions via Proposition 2. We also wish to guarantee that f_R is as least no more pessimistic about average growth than f_L, in than $\mathrm{E}[f_R] \geq \mathrm{E}[f_L]$. With reference to our particular construction of Right and Left, $\mathrm{E}[f_R] = \mathrm{E}[f_L]$. These conditions are summarized as Assumption 3.

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[22]From the development above, these incomes are $\widetilde{y}_R = f_R^{-1}((1-D)\mathrm{E}[f_R])$ and $\widetilde{y}_L = f_L^{-1}((1-D)\mathrm{E}[f_L])$.

Assumption 3. *Right and Left income transitions have been constructed so that Left voters prefer more redistribution that Right voters. In addition, average growth under the Right transition is at least as high as under the Left transition.*

So far, these two assumptions guarantee the left hand side of Equation (6.4) is less than one. Assumption 3 directly implies $\mathrm{E}[f_L]/\mathrm{E}[f_R] \leq 1$, and also that $\widetilde{y}_L > \widetilde{y}_R$. Since the income distribution is unimodal, the density of the distribution F_0' is decreasing for all incomes above the mode. Since by Assumption 2 the incomes $\widetilde{y}_L$ and $\widetilde{y}_R$ are above the mode, it follows that $F_0'(\widetilde{y}_L)/F_0'(\widetilde{y}_R) < 1$. Putting these together, we see Equation (6.4) holds so long as $1 \leq f_L'(\widetilde{y}_L)/f_R'(\widetilde{y}_R)$. As we will illustrate below, this condition can be made intuitive through a graphical analysis, and is in fact is a natural consequence of modeling Right and Left transitions in terms of their curvature. We therefore state our third assumption as $1 \leq f_L'(\widetilde{y}_L)/f_R'(\widetilde{y}_R)$, stated in words as
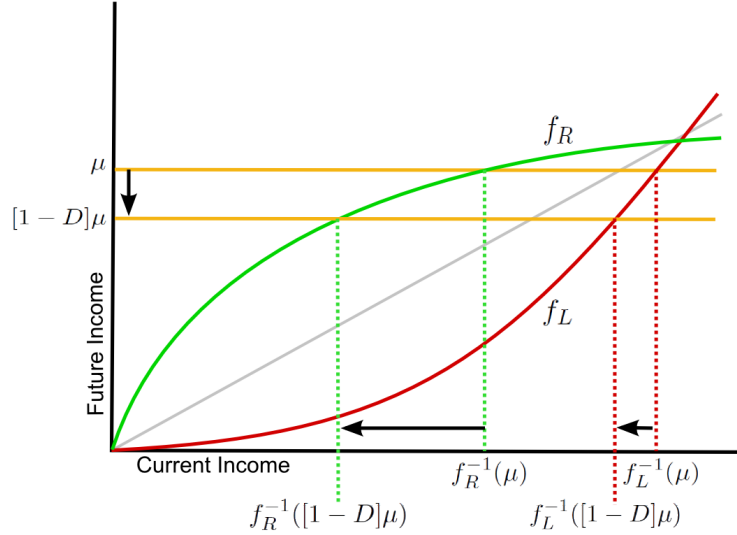
Assumption 4. *At the incomes that Right and Left voters are (respectively) indifferent about redistribution, Left income is increasing faster than Right income.*

In order to explain Assumption 4, we depict idealized transitions f_R and f_L in Figure 8. This figure supposes f_R is concave while f_L is convex, which is approximately true when f_R and f_L are constructed as described above. Fix any future mean income μ above median income, and consider the level of support for redistribution next period as dead weight loss D increases, depicted as a shift in the horizontal line μ to $(1-D)\mu$ in Figure 8. As dead weight loss increases, the fraction of the population supporting redistribution decreases under both f_R and f_L. Under f_R, this decrease is from $F_0(f_R^{-1}(\mu))$ to $F_0(f_R^{-1}([1-D]\mu))$ which in Figure 8 is larger than the drop in support under f_L, from $F_0(f_L^{-1}(\mu))$ to $F_0(f_L^{-1}([1-D]\mu))$. This asymmetric effect of dead weight loss holds because in the illustrated range, the concavity of f_R implies f_R is much flatter than f_L, which is convex. A local characterization that f_R is flatter than f_L is $f_R'(\widetilde{y}_R) \leq f_L'(\widetilde{y}_L)$, which is precisely Assumption 4 and ensures that Equation (6.4) holds. We therefore have Proposition 3.

Proposition 3. *Under Assumptions 2-4, higher levels of deadweight loss further polarize support for redistribution between Right and Left voters.*

Proposition 3 summarizes that when ideologies are modeled as income dynamics, Right voters intrinsically have more aversion to dead weight loss than Left voters. Dead weight loss further polarizes support for redistribution between Right and Left, and when voters update their beliefs away from extreme priors, the effect will be to increase volatility.

FIGURE 8. Polarization from Dead weight Loss

Axis labels: Future Income (vertical), Current Income (horizontal)

f_R

f_L

μ

$[1-D]\mu$

$f_R^{-1}(\mu)$

$f_L^{-1}(\mu)$

$f_R^{-1}([1-D]\mu)$

$f_L^{-1}([1-D]\mu)$

7. CONCLUSION

Adopting the perspective that voters are forward-looking and pay attention to income dynamics, not just to their place in the contemporaneous income distribution, this paper has explored the left-right-left shift in the politics of Latin American countries over the last three or four decades. Two analytical innovations are key to this exploration. The first is a generalization of earlier work on forward-looking voters. We here model political preferences under general families of income distribution dynamics, not just under concave dynamics that offer prospects of upward mobility. This generalization, motivated by empirical evidence of polarizing, non-concave dynamics that offer no prospects of upward mobility for segments of the population, shows that preferences for redistributive policies may increase, not decrease over time when voters are forward-looking. The key message is that unlike a world which offers upward mobility to low income voters, the dynamics of demand for redistribution are not a foregone conclusion and may manifest in volatile political patterns. This points to evaluating the relationship between income dynamics and political choices in light of the conditions voters face on a country-specific basis.

However, detailed analysis of the case of Peru suggests that there would have been initially strong support for redistribution had voters been fully informed about the nature of the income distribution dynamics, making it extremely hard to account for the elections in Peru and elsewhere in Latin America in the 1990s that brought conservative candidates to power. This observation motivates this paper's second innovation, namely its modeling of voters as Bayesian learners who update their understanding of income distribution

dynamics based on their own lived experience. Given that most voters in Peru (and other countries which saw a transition to a market economy in the late 1980s and early 1990s) had little prior experience with the new economic model, we assume that they initially adopted a prior probability distribution that put substantial weight on an ideological position that attached strong prospects for upward mobility to the region's new economic model. Numerical simulation of political preferences as voters received noisy draws from the true (calibrated) income distribution process shows that a substantial shift from strong right political majority to a strong left political majority over the course of about a dozen years. Somewhat surprisingly, political volatility is actually increased when the electorate believes that redistributive policies carry dead weight losses. We show that this volatility of deadweight loss is to be expected under fairly weak assumptions.

Latin America of the 1990s is not only the region to have transitioned to a market economy. While there can certainly be no claim that the precise voting dynamics derived here for Peru apply to other countries, the information deficit and voting dilemma confronted by the Peruvian electorate has had its reflection in a much larger number of countries that have transitioned to political democracy and market economies. Modeling the evolving political preferences of voters in these regions as forward-looking, Bayesian learners offers insights into the complex and often unstable voting patterns observed in these other regions.

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APPENDIX A. RECOVERY OF SIMPLE INCOME DYNAMICS

As developed above, we fit a class of income transitions $f_\beta(y)$ defined by piecewise line segments spanning each income decile. Specifically, these line segments span the midpoints between each income decile (with endpoints defined by incomes at zero and twice the tenth income decile). The years used to determine the midpoints are roughly in the middle of our data sample years: 2001 in Chile and 1998 in Peru. The values of β which maximize Equation (4.2) for each country are reported in Table 1. The parameter values of ρ and $\bar{g}$ which determine Right and Left income transitions are $\rho_{\text{Chile}} = 29.939$, $\rho_{\text{Peru}} = 57.708$ and $\bar{g}_{\text{Chile}} = 1.021$, $\bar{g}_{\text{Peru}} = 1.009$.

TABLE 1. Income Transition Parameters

	Slope of Income Transition in each Decile									
	1	2	3	4	5	6	7	8	9	10
Chile	1.035	1.025	1.028	1.024	1.022	1.023	1.020	1.021	1.024	1.025
Peru	1.032	0.979	1.004	0.998	0.976	1.014	1.000	0.980	1.031	1.023

APPENDIX B. DEPENDENCE OF REDISTRIBUTIVE DEMAND ON INITIAL INCOME

B.1. **Example: Fragility of Redistributive Dynamics.** Consider an income distribution F_0 composed of three equally sized groups with incomes Y_1, Y_2, Y_3 where $0 < Y_1 < Y_2 < Y_3 < \overline{Y}$. Then $\mu_t = \sum(1/3) \cdot f^{(t)}(Y_i)$ and so clearly depends on the initial distribution of income F_0 interacting with the evolution of group incomes $f^{(t)}(Y_i)$. Now also suppose f has three fixed points $Y_{\text{Trap}} < Y_{\text{Escape}} < \overline{Y}$ where for $y < Y_{\text{Escape}}$, $f^{(t)}(y) \longrightarrow Y_{\text{Trap}}$ and for $y > Y_{\text{Escape}}$, $f^{(t)}(y) \longrightarrow \overline{Y}$. In this case all groups are going to either Y_{Trap} or $\overline{Y}$. To fix ideas, assume $Y_1 < Y_{\text{Escape}} < Y_3$ so the Y_1 group converges to Y_{Trap} while Y_3 converges to $\overline{Y}$. Clearly Y_1 prefers the complete redistribution scheme r_1 while Y_3 prefers r_0. This leaves open the middle class of "swing voters" Y_2. If $Y_2 > Y_{\text{Escape}}$ then the middle class eventually climbs the income ladder to $\overline{Y}$ and joins the (now majoritarian) voting block of Y_3. Otherwise, if $Y_2 < Y_{\text{Escape}}$ there is a thinning of the middle class and swing voters eventually join with Y_1, implying the median voter prefers redistribution. Note the fragility of the eventual voting outcomes: a small income difference δ in Y_2 can push $Y_2 + \delta$ to be greater or less than Y_{Escape}. This eventually results in a large fraction p_2 of swing voters to switch their vote as income evolves. Similar consequences can arise if voters lack perfect information about F_0 or f so that small changes in beliefs can give rise to large changes in redistributive preferences.

B.2. **Example: The Same Income Transition Often Can Imply Both Increase and Decreasing Redistributive Demand.** This proposition shows that a broad class of dynamics can exhibit either increasing or decreasing demand for redistribution. The deciding factor for redistributive dynamics, even for a fixed dynamic, is the initial distribution of income. This emphasizes the interrelationship between "Upward/No Mobility" in the dynamic role of income transitions and the "existing order" in the role of the income distribution: political implications cannot be drawn without considering both.

Proposition. *Suppose f is bounded and define $f^{(\infty)}(y) \equiv \lim_{t\to\infty} f^{(t)}(y)$ as an individual's income after an arbitrarily long period of time. Let $\underline{\mu}_\infty$ be the least possible per capita income under $f^{(\infty)}$ and let $\overline{\mu}_\infty$ be the highest possible per capita income under $f^{(\infty)}$.*

(1) *(POUM Forever) If $\left[\underline{\mu}_\infty, \overline{\mu}_\infty\right]$ intersects the interior of Y_{POUM}, there is an initial distribution of income where the demand for redistribution always decreases.*
(2) *(No-POUM Forever) If $\left[\underline{\mu}_\infty, \overline{\mu}_\infty\right]$ intersects the interior of Y_{NoPOUM} there is an initial distribution of income where the demand for redistribution always increases.*

Proof. Formally, we have $\underline{\mu}_\infty \equiv \inf_{F_0} \int f^{(\infty)} dF_0$ and $\overline{\mu}_\infty \equiv \sup_{F_0} \int f^{(\infty)} dF_0$ where the infimum and supremum are taken over bounded, absolutely continuous initial income distributions. $\underline{\mu}_\infty$ and $\overline{\mu}_\infty$ are both in $[0,\infty)$ as for any fixed F_0, f is bounded so $\int f^{(\infty)} dF_0 = \lim_{t\to\infty} \int f^{(t)} dF_0$ by bounded convergence, and clearly each $\int f^{(t)} dF_0 \in [0, \sup f]$.

We will consider the POUM case as the other case is similar. By hypothesis, there is some $\mu^* \in \left[\underline{\mu}_\infty, \overline{\mu}_\infty\right]$ and an open set V such that $\mu^* \in V \subset Y_{POUM}$. Fix $\varepsilon > 0$ such that $\mu^* \pm \varepsilon \in V$ and fix λ such that $\mu^* = \lambda \underline{\mu}_\infty + (1-\lambda) \overline{\mu}_\infty$ (note this forces $\lambda \in [0,1]$). Now define, for any initial income distribution G, $\mu_t^G \equiv \int f^{(t)} dG$. By definition of $\underline{\mu}_\infty$ and $\overline{\mu}_\infty$ we may choose initial income distributions $\underline{F}$ and $\overline{F}$ where

$$\lim_{t\to\infty} \mu_t^{\underline{F}} < \underline{\mu}_\infty + \varepsilon/2 \quad \text{and} \quad \lim_{t\to\infty} \mu_t^{\overline{F}} > \overline{\mu}_\infty - \varepsilon/2.$$

It follows that there is a T such that for all $t \geq T$, $\mu_t^{\underline{F}} < \underline{\mu}_\infty + \varepsilon$ and $\mu_t^{\overline{F}} > \overline{\mu}_\infty - \varepsilon$. This implies $\left| \lambda \mu_t^{\underline{F}} + (1-\lambda) \mu_t^{\overline{F}} - \left[\lambda \underline{\mu}_\infty + (1-\lambda) \overline{\mu}_\infty \right] \right| < \varepsilon$ for all $t \geq T$. Since $\lambda \underline{\mu}_\infty + (1-\lambda) \overline{\mu}_\infty = \mu^*$ and $\tilde{F} \equiv \lambda \underline{F} + (1-\lambda) \overline{F}$ is an admissible initial income distribution, we see $\left| \mu_t^{\tilde{F}} - \mu^* \right| < \varepsilon$ for all $t \geq T$. By construction, this implies $\mu_t^{\tilde{F}} \in V \subset Y_{POUM}$, so by Proposition 1, the demand for redistribution is always decreasing when the initial distribution of income is $F_0(y) \equiv \tilde{F}(f^{(T)}(y))$. $\qquad\square$

APPENDIX C. DEMAND FOR REDISTRIBUTION UNDER IMPERFECT INFORMATION

In general, neither f_L nor f_R need reflect reality but rather idealized versions of what Left and Right ideologues might represent in a manifesto. Clearly the relative strength of a voter's beliefs in these world views will influence voting behavior. In order to emphasize the role of beliefs $\pi_{it}(\lambda|H_{it})$ in deriving a voter's expected income, we now illustrate the decisions of a pocketbook voter who is also a Bayesian learner.

If a voter knows the true value of λ, namely λ_0, then beliefs $\pi_{i0}(\lambda)$ put a point mass of 1 on λ_0. This is the perfect information case, and as above expected income in period 1 would be given by $\mathrm{E}[y_{i1}|H_{i0}, \pi_{i0}] = f_{\lambda_0}(y_{i0})$. However, each voter does not know λ_0 with certainty but has a non-degenerate prior density $\pi_{i0}(\lambda)$ over possible values of λ. Now consider a voter in period 0 with income y_{i0}. The voter's expected income in period 1 is a weighted average of expected income over plausible values of λ, namely $\mathrm{E}[y_{i1}|H_{i0}, \lambda = \lambda_0] = f_\lambda(y_{i0})$ weighted by $\pi_{i0}(\lambda)$. Specifically,

$$\mathrm{E}[y_{i1}|H_{i0}, \pi_{i0}] = \int_0^1 \mathrm{E}[y_{i1}|H_{i0}, \lambda]\pi_{i0}(\lambda)d\lambda = \int_0^1 f_\lambda(y_{i0})\pi_{i0}(\lambda)d\lambda$$

More generally, at the end of periods 1 to t, a voter updates his prior $\pi_{i0}(\lambda)$ to a posterior $\pi_{it}(\lambda)$ using his new history $H_{it} = \{y_{i0}, \ldots y_{it}\}$. Therefore expected income in period $t+1$ is given by

(C.1) $$\mathrm{E}[y_{it+1}|H_{it}, \pi_{i0}] = \int \underbrace{f_\lambda^{(t+1)}(y_{i0})}_{\text{Expected Income}|\lambda} \cdot \underbrace{\pi_{it}(\lambda|H_{it})}_{\text{History Dependent Beliefs Over }\lambda} d\lambda$$

Equation (C.1) highlights the two dynamic factors which influence a voter's beliefs about expected income. The first element, expected income given λ is the true state of the world, is deterministic as under perfect information. The second element, a voter's ideological beliefs, evolve as information is collected in the form of the idiosyncratic income history H_{it}.

Since each possible value of λ corresponds to an economy wide income dynamic, a voter's beliefs also impact expectations about mean income next period. Specifically, mean income in period $t+1$ given f_λ is the true income dynamic is $\mu_{t+1}|\lambda \equiv \int f_\lambda^{(t+1)}(y)dF(y)$. Thus, a voter with an income history H_{it} and prior π_{i0} believes mean income in period $t+1$ is given by

$$\mathrm{E}[\mu_{t+1}|H_{it}, \pi_{i0}] = \int_0^1 [\mu_{t+1}|\lambda] \cdot \pi_{it}(\lambda|H_{it})d\lambda$$

(C.2) $$= \int_0^1 \left[\int f_\lambda^{(t+1)}(y)dF(y)\right]\pi_{it}(\lambda|H_{it})d\lambda$$

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After accounting for any dead weight loss D, a voter will prefer redistribution if and only if $E[(1-D)\mu_{t+1}|H_{it}, \pi_{i0}] \geq E[y_{it+1}|H_{it}, \pi_{i0}]$. From Equations (C.1) and (C.2) this means voters prefer redistribution when

$$(C.3) \qquad \int_0^1 \underbrace{\left[(1-D) \int f_\lambda^{(t+1)}(y)dF(y) - f_\lambda^{(t+1)}(y_{i0}) \right]}_{\text{Expected Transfer}|\lambda} \cdot \pi_{it}(\lambda|H_{it})d\lambda \geq 0$$

Equation (C.3) shows that a voter prefers redistribution when, *given their history H_{it}*, they believe the expected transfer from redistribution will be positive. Note that two voters with the same initial incomes need not have the same redistributive preferences: whether Equation (C.3) holds depends on each voter's income history through their beliefs $\pi_{it}(\lambda|H_{it})$. This implies the popularity of redistributive policies varies in a nontrivial way across initial incomes. Preferred policies for each voter, conditional on their history H_{it}, are summarized in Equation (C.4).

$$(C.4) \qquad \begin{array}{c} \text{Period} \\ t+1 \\ \text{Policy} \end{array} = \begin{cases} \text{Redistribute,} & \int \left[(1-D)\mu_{t+1}|\lambda - f_\lambda^{(t+1)}(y_{i0}) \right] \pi_{it}(\lambda|H_{it})d\lambda \geq 0 \\ \text{Laissez Faire,} & \int \left[(1-D)\mu_{t+1}|\lambda - f_\lambda^{(t+1)}(y_{i0}) \right] \pi_{it}(\lambda|H_{it})d\lambda \leq 0 \end{cases}$$

Equation (C.4) allows us to make a clear connection from ideological beliefs to demand for redistribution through the following assumption:

Assumption. *Increases in λ imply expected income improves relative to transfers ($\frac{d}{d\lambda} f_\lambda^{(t)}(y_{i0}) \geq \frac{d}{d\lambda}(1-D)\mu_t|\lambda$) for all swing voters defined as y_{i0} where*

$$y_{i0} \in \left[f_R^{(-t)}\left((1-D)\mu_t|\lambda=1\right), f_L^{(-t)}\left((1-D)\mu_t|\lambda=0\right) \right] \quad \text{(Swing Voters)}$$

This Assumption says that as λ increases (moves to the Right), each voter believes his expected income $f_\lambda^{(t)}(y_{i0})$ increases *relatively more* than expected transfers $(1-D)\mu_t|\lambda$. Furthermore, we only require this to hold for voters who might potentially change their vote: the votes of both destitute ($f_\lambda^{(t)}(y_{i0}) < (1-D)\mu_t|\lambda$ for all λ) and well-to-do ($f_\lambda^{(t)}(y_{i0}) > (1-D)\mu_t|\lambda$ for all λ) are unaffected by belief.

Assumption C implies the expected transfer $(1-D)\mu_t|\lambda - f_\lambda^{(t)}(y_{i0})$ is decreasing in λ. It follows that voter j tends to prefer less redistribution than voter i when voter j's beliefs π_{jt} are "to the Right" of a voter i's beliefs π_{it}. To make this precise, assume that π_j stochastically dominates π_i and i and j have the same initial incomes. Since for each fixed λ, $(1-D)\mu_t|\lambda - f_\lambda^{(t)}(y_{i0}) = (1-D)\mu_t|\lambda - f_\lambda^{(t)}(y_{j0})$ and this equation is decreasing in λ, the

dominance of π_j over π_i implies

$$\text{(C.5)} \quad \int \underbrace{\left[(1-D)\,\mu_t | \lambda - f_\lambda^{(t)}(y_{j0}) \right]}_{\text{Expected Transfer} | \lambda} \pi_{jt}(\lambda)d\lambda \le \int \underbrace{\left[(1-D)\,\mu_t | \lambda - f_\lambda^{(t)}(y_{i0}) \right]}_{\text{Expected Transfer} | \lambda} \pi_{it}(\lambda)d\lambda$$

Equation (C.5) shows that the "Right" voter j believes they will receive a lower net transfer from redistribution than the "Left" voter i. Therefore voter j tends to prefers less redistribution than voter i. This result which connects ideological belief to redistributive demand is summarized as Proposition 4.

Proposition 4. *Suppose the Assumption above holds. If voters i and j are identical except voter j's beliefs π_{jt} stochastically dominate voter i's beliefs π_{it}, then j prefers less redistribution than i.*

Proposition 4 shows that the further to the ideological Right a voter is, the less redistribution they prefer. In this framework, one would expect that the speed of learning would be related to both the variability of income signals and the gap between left and right predictions for an individual's future income position. These expectations imply a rich set of testable implications about the evolution of political preferences and voting that we hope to explore in future work.

APPENDIX D. PROOFS

Lemma. *Suppose f and g are continuous where g is defined on $f((-\infty, \infty))$. Then g is concave iff $g\left(\mathrm{E}\left[f(X)\right]\right) \ge \mathrm{E}\left[g(f(X))\right]$ for all bounded random variables X.*

Proof. Fix $a, b \in f^{-1}((-\infty, \infty))$, $\lambda \in [0,1]$ and some $\tilde{a}, \tilde{b}$ where $\tilde{a} \in f^{-1}(a)$ and $\tilde{b} \in f^{-1}(b)$. For each $\delta > 0$ define a distribution

$$H_\delta(x) \equiv \int_{-\infty}^{x} \left[(\lambda/2\delta) \cdot \mathbf{1}_{[\tilde{a}-\delta,\tilde{a}+\delta]}(t) + ((1-\lambda)/2\delta) \cdot \mathbf{1}_{[\tilde{b}-\delta,\tilde{b}+\delta]}(t) \right] dt$$

where $\mathbf{1}_A(t)$ denotes the indicator for t contained in the set A. Clearly each H_δ is the distribution of a bounded random variable. We will show that

$$\text{(D.1)} \quad g(\lambda a + (1-\lambda)b) = \lim_{\delta \to 0} g\left(\int f dH_\delta \right) \ge \lim_{\delta \to 0} \int g \circ f dH_\delta = \lambda g(a) + (1-\lambda)g(b)$$

By assumption, $g\left(\int f dH_\delta\right) \geq \int g \circ f dH_\delta$ for each δ, so all that remains to show are the values of each limit in Equation (D.1). First, we evaluate $\lim_{\delta \to 0} g\left(\int f dH_\delta\right)$ and consider

$$\left|\int f(t)\frac{\lambda}{2\delta}\mathbf{1}_{[\tilde{a}-\delta,\tilde{a}+\delta]}(t)dt - \lambda a\right| = \frac{\lambda}{2\delta}\left|\int_{-\delta}^{\delta} f(f^{-1}(a)+t) - f(f^{-1}(a))dt\right|$$

(D.2)
$$\leq \frac{\lambda}{2\delta} \cdot 2\delta \cdot \sup_{|t|\leq\delta}\left|f(f^{-1}(a)+t) - f(f^{-1}(a))\right| \longrightarrow 0$$

as $\delta \longrightarrow 0$ because f is continuous at $f^{-1}(a)$. Similarly, as $\delta \longrightarrow 0$,

(D.3)
$$\left|\int f(t)\frac{(1-\lambda)}{2\delta}\mathbf{1}_{[\tilde{b}-\delta,\tilde{b}+\delta]}(t)dt - (1-\lambda)b\right| \longrightarrow 0$$

and putting Equations (D.2) and (D.3) together we conclude that $\lim_{\delta \to 0}\int f dH_\delta \longrightarrow \lambda a + (1-\lambda)b$. Continuity of g then implies that $\lim_{\delta \to 0} g\left(\int f dH_\delta\right) = g(\lambda a + (1-\lambda)b)$.

Finally, since g is continuous, the argument above can be repeated taking $g \circ f$ in place of f, which shows $\lim_{\delta \to 0}\int g \circ f dH_\delta = \lambda g(a) + (1-\lambda)g(b)$. Therefore we conclude Equation (D.1) holds, so g is concave. $\qquad\square$