Trade Liberalization, Labor Reforms and Formal-Informal Employment Dynamics*

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March 5, 2010

Abstract: This paper studies gross worker flows to explain the rising informality in Brazilian metropolitan labor markets from 1983-2002. In particular, we examine the impact of trade and constitutional reforms, (that include increased firing costs, tighter restrictions on overtime work, and fewer restrictions on union activity) occurring during the period. We find aggregate sectoral movements to be driven largely by changes in the hiring rates which, in turn are driven largely by the constitutional reforms. Trade liberalization accounts for roughly 1% of the increase in informality, while the constitutional reforms account for 40-50%.

JEL Classification: J23, J38, J63, J65, O17, F16
Keywords: Gross worker flows, Labor market dynamics, Informality, Developing Countries.

*We are very grateful to Francisco Carneiro, Marcello Estevao, Gustavo Gonzaga Lauro Ramos, Jose Guilherme Reis and Gabriel Ulyssea, to participants in the NBER workshop on informality, October 2006 in Bogota, and to those at the University of Michigan conference on Labor Markets in Developing and Transition Economies, May 2007, in particular Gary Fields, Ann Harrison, Ravi Kanbur, and Jan Svejnar, for helpful advice and reality testing of ideas. We are grateful to Lauro Ramos for providing the old PME dataset for 2002. This research was partially funded by the Regional Studies Program of the Latin American and Caribbean Regional of the World Bank. All conclusions are, of course, our own. Correspondence: m.bosch@merlin.fae.ua.es, Edwin.Goni@EUI.eu, wmaloney@worldbank.org.

I. Introduction

A growing literature explores the insights that labor flows can shed about how regulations and institutions affect the functioning of labor markets. On the theoretical side, Bertola and Rogerson (1997), Alvarez and Veracierto (1999), Mortensen and Pissarides (2003), Pries and Rogerson (2005) have all analyzed the impact of policy reforms on labor market flows in a search and matching context. These modeling efforts offer well-defined predictions of gross labor flows and hence a disaggregated view of the processes underlying observed trends in unemployment stocks. For the developing world, the impact of regulations on what is perhaps the distinguishing characteristic of poor country labor markets, the large unregulated or informal sector, has recently been explored by Kugler (2004), Zenou (2008) and Albrecht, Navarro and Vroman (2009).

On the empirical side, the advanced country literature has looked at the impact of employment protections on worker and job flows (see, for example, Messina and Vallanti, 2007, for Europe, Kugler and Pica, 2008, for Italy). Although data is less easily available[1], developing countries often offer more extreme policy experiments. Indeed, the evolution of the Brazilian labor market from 1990 to 2000 offers an especially dramatic experiment. Across this single decade, the share of the metropolitan area work force unprotected by labor legislation and thereby classified as "informal" rose an astronomical ten percentage points. Dramatic outcomes often spring from dramatic innovations and Brazil offers several significant policy changes across the period. The end of the 1980s saw a far reaching trade reform, and the establishment of a new constitution in 1988 that had substantial impacts on labor costs and flexibility. In particular, it increased overtime costs, raised substantially the penalty for firing workers, and importantly relaxed restrictions on union activity.

However, the empirical work to date has been surprisingly indeterminate. Looking at separations from formal sector work, Paes de Barros and Corseuil (2004)

[1]Boeri and Burda (1996) found a limited impact on job matches of active labor market policies in the Czech Republic during the transition from socialism. Hopenhayn (2004) found that the introduction of fixed term contracts and of special trial period provisions in Argentina led to higher separations from formal employment. Kugler (1999, 2004) found the reduction of firing costs in Colombia led to greater exit rates in and out of unemployment as well as a reduction in unemployment

found, unexpectedly, no impact of the very large rise in firing costs. Looking at the impact of the reduction in trade protection, Menezes-Filho and Muendler (2007) find mixed results on outflows from formal employment and into informality, depending on specification, while Goldberg and Pavcnik's (2003) work finds no impact on the size of the informal sector.

We revisit this experiment, analyzing the impact of a set of trade and labor reforms. We argue that, conceptually, the effects of these policies on the overall level of informality work through both relative informal/formal inflows and outflows and that the overall impacts can be ambiguous. This underscores the need to look at the full set of adjustments when evaluating the impact of reform. We then estimate the impact on the overall level of informality as well as the relative flows using a detailed and extensive rotating panel data set. Taking advantage of the differential impact of reforms across industries, we find little compelling evidence that trade reform was the prominent or even statistically significant factor. All three labor related dimensions of the constitutional reform however, appear more important. In all cases, the effect comes more through lower formal job finding rates as opposed to the separations that Paes de Barros and Corseuil (2004) investigated. We estimate that around 40% of the trend in informality can be explained by changes related to the constitutional reform while changes in trade can explain no more than 1% of the trend.

II. Data and context

The period from the late 1980s to the first half of the 1990s was a turbulent one, comprising a persistent hyperinflation and six major stabilization plans designed to control it, a constitutional change, and several other reforms including a dramatic reduction in barriers to trade. Across the whole period Brazil experienced the 1990 crisis and slowdowns in 1999 and 2001 with corresponding recoveries.

We draw on the Monthly Employment Survey (Pesquisa Mensal de Emprego, hereafter PME[2]) that conducts extensive monthly household interviews in 6 of the major

[2] For descriptions of the methodology of the Pesquisa Mensal de Emprego, see Sedlacek, Barros and Varandas (1990), IBGE (1991) and Oliveira (1999).

metropolitan regions (São Paulo, Rio de Janeiro, Belo Horizonte, Porto Alegre, Recife and Salvador) and covers roughly 25% of the national labor market. The questionnaire is extensive in its coverage of participation in the labor market, wages, hours worked, benefits received, and other variables that are traditionally found in such employment surveys. We also draw on the National Household Survey (Pesquisa Nacional por Amostra de Domicilios or PNAD) for selected cross checks. The PNAD covers the entire country, but lacks any panel dimension and hence is not suitable for the study of gross labor flows.

The PMEs structure as a rotating panel allows us to create time series of gross labor market flows. It tracks workers across four consecutive months, then drops them from the sample for 8 months, and then reintroduces them for another 4 months. Each month one fourth of the sample is substituted with a new panel. After 12 months the initial sample is re-interviewed. Over a period of two years, three different panels of households are surveyed, and the process starts again with three new panels. Regrettably, the PME was drastically modified in 2002 and it is not possible to reconcile the new and old definitions for unemployment and job sectors.[3] Hence, our analysis begins in 1983 and stops at 2002.

We follow the literature in dividing employed workers into three sectors.[4] The formal salaried (F) are those public and private employees whose contract is registered or signed (asinada) in his/her work-card (carteira de trabalho) as dictated by Brazilian law. This registration entitles the worker to labor rights and benefits including 30 days of paid holiday per year, contributions for social security, the right to request unemployment benefit in case of dismissal, monetary compensation if dismissed without a fair cause, and maternity and paternity paid leave among others benefits. The informal salaried (I) are those employees whose work card has not been signed (sem carteira or without carteira). Finally, the informal self employed (S.E.) are workers who are not employees and hence are not covered by the benefits afforded by a signed work card. Ideally, we might also employ a definition of informality based on firm size as

[3].The unemployment rate jumps from 8% to 14 % after the change in methodology of the PME.

[4] There is broad consensus in the literature on the definition of informality in the Brazilian literature. A comprehensive survey of work studying the size and evolution of the Brazilian informal sector in the labor market can be found in Ulyssea (2005) and a summary of stylized facts of the eighties and nineties is detailed in Ramos and Reis (1997), Ramos (2002), Ramos and Brito (2003), Veras (2004), and Ramos and Ferreira (2005a, b).

well, focusing on establishments of fewer than 5-10 as informal employees. However, the PME until 2002 does not tabulate this information.[5] That said, Henley et al (2009) find that there is a close correspondence between access to protections, our measure of informality (employment registration), as well as size.

Figure 1 plots the share of informal employment (comprising both informal workers and self-employed) over total employment from 1983-2002. The share of informal employment remained relatively constant around 35% of the work force during the 1980's despite major macroeconomic shocks. However, as has been documented by numerous previous studies (See for example, Ramos and Reis 1997, Ramos 2002, World Bank and IPEA 2002, Ramos and Brito 2003, and Goldberg and Pavcnik 2003, Veras 2004, Ulyssea 2005, and Ramos and Ferreira 2005a,b) the share begins a major secular upturn at the beginning of the 1990s that levels off at 45%, 10 percentage points above its level at the beginning of the 1990s.

These movements in formal sector size are necessarily a function of inflows and outflows into each sector relative to the other. The next two panels of figure 1 present the evolution of these two series that compactly and completely capture the relevant dynamics: inflows into informal employment relative to those into formal; and outflows from informal employment relative to outflows from formal employment. We calculate relative inflows for each year the number of workers transiting into an informal sector job (from unemployment, out of the labor force or formal jobs) relative to those transiting to a formal sector job (from unemployment, out of the labor force or an informal jobs). Analogously, we calculate the relative outflows of informal jobs relative to formal jobs. It is clear that relative inflows into informality (formality) were strongly countercyclical (procyclical) until the beginning of the 1990s. However after 1992, the relationship breaks down with relative accessions into formality no longer tracking the economic recovery of the next five years. Relative outflows from informality (panel 3) also show a secular decline across the entire period.

[5] The ILO for a period defined informality as consisting of all own-account workers (but excluding administrative workers, professionals and technicians), unpaid family workers, and employers and employees working in establishments with less than 5. In fact, Bosch and Maloney (2006) find that in Mexico, the criteria of small firm size and ours of lack of registration are similar in motivation conceptually and lead to a great deal of overlap. 75% of informal workers are found in firms of 10 or fewer workers. Since owners of firms or self-employed are not obliged to pay social security contributions for themselves, we in fact consider them as informal self-employed with no social security contributions (and hence without the benefits that are perceived by salaried workers holding a *carteira*).

Table 1 suggests that only a small part of this is due to changes in economic structure. Consistent with figure 1, there are virtually no changes in either the share of total employment by sector or the sectoral degree of informality in the 1983-1988 period. The 1990s, by contrast, saw a fall in the share of tradables (manufactures) of 10 percentage points, a phenomenon labeled the tertiarization of the Brazilian economy. However, the impact of this reallocation on informality is dwarfed by the intra-sectoral evolution: formality decreased within 28 of the 30 sectors in the table, falling 16% in manufacturing overall, and reaching 23% in some sectors.[6] This is broadly consistent with Ramos (2002) and Goldberg and Pavcnik (2003) who find that the vast majority, of the increase in the informal employment, in the latter study eighty-eight percent, arises from movement of workers from formal to informal jobs *within* industries.[7] Hence, the source of the secular rise in informality is largely working through the within composition of subsectors of workers, formal and informal and our modeling strategy reflects this.

Decomposing gross flows

We can generalize the preceding discussion at the industry level. In practice transitions into an informal job in a given industry may occur not only from other employment sectors, but also from other jobs within the same industry or from other industries. The law of motion of the number of informal workers in a given industry, m is given by

$$\dot{n}_{i,m} = u * f_i^{\,m} + n_{f,m} * d_m^{\,m} + \sum_{j \neq m} (n_{i,j} * j_j^m + n_{f,m} * d_j^{\,m}) - (s_i^m + g_m^m + \sum_{j \neq m} (j_m^j + g_m^j)) n_{i,} \quad (1)$$

Equation (1) indicates that the change in the total number of informal jobs in industry *m* is determined by four sets of flows. First, unemployed and out of the labor force workers (*u*) find informal jobs in industry *m* at rate f_i^m. Second, within industry

[6] The share of formal employment only increases among domestic workers and in the clothing services sector The Union of Women Domestic Employees (UWDE) in Brazil - which originally was established as an association - won the status of a trade union in 1989. In 1992, UWDE became an affiliate of the Central Workers Union (CUT), which considerably increased the number of its members (Ülku 2005)

[7] Similar results are reported by Bosch and Maloney (2006) for the Mexican case.

m, formal jobs, $n_{f,m}$, are downgraded into informal jobs at a rate $d_m{}^m$. Third, from other industries informal ($n_{i,j}$) and formal ($n_{f,j}$) workers transit to informal jobs in industry *m* at rate, j_j^m and $d_j{}^m$ respectively. Finally, the last term of equation (16) represents the outflow of informal jobs from industry *m*. This outflow may occur towards unemployment (and out of the labor force) at rate s_i^m, towards other informal jobs within industry *m*, g_m^m, and other jobs (formal and informal) in and industry different than *m*, $\sum_{j\neq m}(j_m^j + d_m^j)$. The analogous law of motion for formal jobs in industry *m is:*

$$\dot{n}_{f,m} = u * f_f^m + n_{i,m} * g_m{}^m + \sum_{j\neq m}(n_{f,j} * t_j^m + n_{i,j} * g_j{}^m) - (s_f^m + d_m^m + \sum_{j\neq m}(t_m^j + d_m^j))n_{f,m} \quad (2)$$

Where in this case t_j^m and t_m^j denote the job to job transition rates of formal workers between industries *j* and *m* respectively. The steady state relative sizes of the formal to informal sectors in industry *m* can be written using equations (1) and (2) as

$$\gamma_m^{ss} = RI_{i,m} / RO_{i,m} \quad (3)$$

where $RI_{i,m}$ and $RO_{i,m}$ represent the relative inflows and outflows of informal workers in industry *m,* and in the steady state are

$$RI_{i,m} = \frac{u * f_i{}^m + n_{f,m} * d_m{}^m + \sum_{j\neq m}(n_{i,j} * j_j^i + n_{f,m} d_j{}^m)}{u * f_f^m + n_{i,m} * g_m{}^m + \sum_{j\neq m}(n_{f,j} * t_j^m + n_{i,j} g_j{}^m)} \quad (4)$$

$$RO_{i,m} = \frac{(s_i^m + g_m^m + \sum_{j\neq m}(j_m^j + g_m^j)))}{(s_f^m + d_m^m + \sum_{j\neq m}(t_m^j + d_m^j)}$$

Using the panel structure of the PME and equations (3) to (4) we can compute the steady state values of the share of informal employment of industry *m*.

$$i_m^{ss} = \frac{\gamma_m^{ss}}{1+\gamma_m^{ss}} \quad (5)$$

These steady state values are remarkably similar to the actual series. Figure 2a shows the scatter plot of the actual share of informal workers and its steady state derived from equation (5) by industry for all years from 1983 to 2002. Virtually all data points lie close to the 45 degree line. Furthermore, we aggregate across sectors to show how the evolution of the steady state share of informal workers tracks the actual share over time. This is shown in figure 2b. The message is the same. Because the magnitude of flows is relatively high the steady state value of the share of informal employment is a very good approximation to the actual series.

In addition, this exercise allows us to decompose the changes in the share of informal employment by industry into changes in the relative inflows and the relative outflows. In particular, the growth rate of γ_m^{ss} can be decomposed into changes in $RI_{i,m}$ and $RO_{i,m}$.

$$\frac{\dot{\gamma}_m^{ss}}{\gamma_m^{ss}} = \frac{\dot{RI}_{i,m}}{RI_{i,m}} - \frac{\dot{RO}_{i,m}}{RO_{i,m}} \tag{6}$$

Table 2 shows this decomposition for the period 1983-1988 and 1988-2000 for all the industries in our sample. On average around 76% of the changes in the share of informal employment were due to the increased entry into informality relative to inflows into formal employment. The remaining 24% was due to changes in the relative outflows from informality. The rest of the article examines how the trade and labor reforms affected these flows and hence the aggregate rise in informality.

III. Policy Innovations

We explore two major policy shocks that were at play in Brazil across the period and which are likely to have had a major role on these flows, and hence in the reallocation of the work force from formal into informal employment: the opening of the Brazilian economy to foreign trade, and the 1988 constitutional reforms. Annex I presents an illustrative model in the matching context that offers some structure for thinking through these effects in a matching context. For the most part, however, the

effects are straightforward heuristically and the model mostly helps in showing whether we may expect an impact on relative flows in or out of formality (or both) and where net effects may be ambiguous.

It is worth highlighting that conceptually, these effects can occur in a context of a competitive or integrated labor market where, at the margin, workers are indifferent between formal and informal sectors. Hence the model in Annex I works more in a context of informality as discussed by Maloney (1998), Bosch and Maloney (2010) among others where the market is not necessarily segmented and hence informality is not intrinsically inferior to formal employment. In very simple terms, any policy innovation that causes formal firms to see lower productivity per worker implicitly "shifts in" the demand for formal labor, but does not imply segmentation, since the marginal worker is indifferent between working in the formal or the informal sector. Similarly, changes in labor regulations may lead to a shifting up of the labor supply curve in such a way that less formal labor is hired, but, again, there is no segmentation. Clearly, this approach does not exclude segmentation emerging from the reforms as well.

Trade liberalization

Far reaching trade reform began in the mid 1980s but intensified around 1990. Figure 3 plots two variables measuring the degree of trade protection of the Brazilian economy during the period; Muendler's (2002) import penetration ratio, and Kume et al.'s (2003) real effective trade tariffs rates.[8] The trade opening translated into a dramatic reduction to one third of the level of effective protection (from 1988 to 2002) and to a doubling of imports penetration rates (during the same period).

As Pavcnik and Goldberg (2003) argue, the fact that Brazil had not participated in the tariff-reducing GATT rounds prior to the trade reforms implies that the usual concerns about the endogeneity of trade policy changes and political economy of protection are attenuated. As they argue, the government's objective when reducing

[8] Effective protection is preferred to nominal tariffs as before 1988 non-tariff barriers implied that most tariffs were redundant, That is the tariffs exceeded the differential between internal and external prices (see Hay 2001 and Kume et al. 2003).

tariff rates across industries was to achieve the relatively uniform tariff rate negotiated with the WTO and hence policy makers were accordingly less concerned with catering to special lobby interests. This is supported by figure 4. We compare the tariff levels of 1988 against those in the year 2000. We confirm Pavcnik et al.'s (2002) findings that tariff declines in each industry are proportional to the industry's pre-reform tariff level in 1988.

The impact of trade liberalization is theoretically ambiguous. On the one hand, lower barriers increase the competition that an industry exposed to trade faces. The lost formal profitability both reduces hires into, and increases separations from, the formal sector. Both effects work in the same direction of a reduction in the share of formal employment. However, reducing tariffs and quotas also permits greater access to imported capital goods and other intermediate inputs that may increase productivity, or improve the quality of output that may enhance competitiveness relative to imports or in export markets. This implies exactly the opposite effects.

To date, the most thorough test of the hypothesis of a relationship between trade liberalization and informality was undertaken by Goldberg and Pavcnik (2003) who, exploiting sectoral variation in protection across time, found no relationship with the share of informality in Brazil, and a modest relationship in Colombia. More recently, Soares (2005) and Menezes-Filho and Muendler (2007) find a significant effects of trade liberalization on the labor market although the impact on the size of the informal sector is sensitive to the inclusion of firm fixed effects.

We follow Goldberg and Pavcnik (2003) in exploiting the inter-industry variation of the impacts of trade liberalization over time using the Muendler (2002) and Kume et al. (2003) proxies. The variation is large across sectors especially since we expand our coverage beyond the manufacturing sectors and include non-tradable sectors services which, in principle, are less directly affected by the opening of the economy. Panel (a) in figure 5 plots the log change in the share of informal workers by industry against the log change in tariffs and import penetration from 1988 to 2000, suggesting an unconditional correlation between the change in informality with changes in effective tariffs and virtually zero correlation with changes in import penetration.

Constitutional Reforms

The 1988 constitutional changes had important implications for the labor code in several areas that theory predicts could lead to increasing informality. First, there was a generalized increase in labor costs and reduction in formal employer flexibility. Maximum working hours per week were reduced from 48 to 44, overtime remuneration was increased from 1.2 to 1.5 times the normal wage rate; vacation pay was raised from one to 4/3 of the monthly wage, and maternity leave increased from 90 to 120 days.[9] Second, the power of organized labor was expanded. Unions were no longer required to be registered and approved by the Ministry of Labor; decisions to strike were now left purely to union discretion, and the required advance notification to the employer cut from five to two days; and strikes in certain strategic sectors were no longer banned. Finally, firing costs were raised. The penalty levied on employers for unjustified dismissal, a category encompassing most legitimate separations for economic reasons in the US, increased by four times from 10% to 40% of the accumulated separation account (FGTS, Fundo de Garantia por Tempo de Serviço). These are private funds into which the employer by law must contribute, every month, the equivalent of 8% of the employee's monthly wage. The accumulated value is thus a function of tenure and the average wage of the worker over that tenure. Workers only have access to the fund if dismissed, but on dismissal, they receive the entire fund, plus a penalty in proportion to the accumulated fund in the job from which they are being dismissed (See Paes de Barros and Corseuil 2004 for more detail).

To date, the most comprehensive work relating these changes to the functioning of the labor market was undertaken by Paes de Barros and Corseuil (2004) who find that separation rates decreased after the constitutional changes for short employment spells and increased for longer spells, but find inconclusive results about impacts on flows into informality from the formal sector. However, again, matching models such as that sketched in Annex I suggest that several of these reforms would lead to a reduction in

[9] Paes de Barros and Corseuil (2004) among others also note that the maximum continuous work day was reduced from 8 to 6 hours although the exact meaning of this is unclear given that 8 hours remains the standard work day.

hiring (job finding) rates as opposed to the separations that Paes de Barros and Corseuil (2004) study. We find very strong impacts through this second channel as well.

The constitutional reform was implemented one off and simultaneously for all sectors. This implies that we must rely entirely on the cross industry variation in the impact of this shock for identification.

Overtime Pay: An increase in overtime pay raises labor costs and this leads both to reduced formal hiring relative to informal hiring, and an increase in the relative separation from formal jobs (see annex I). Both forces imply a reduction in the share of formal employment. Further, we argue that the impact will be greater in those industries where the use of overtime (prior to the reform) was greater. Hence, we expect that industries with a higher share of their working hours above the post constitutional maximum hours a week would see the greatest impact.

It is important to note a potential countervailing numeraire effect: Though total hours worked by formal workers may fall, the fewer hours that each employee may legally work implies that the number of workers may actually rise. Determining the net effect requires knowledge of the number of overtime hours, the cost imposed by the overtime legislation, and especially the elasticity of formal/informal labor demand, two out of three of which we do not know.

We use the pre-reform share of workers above the 44 hour limit as a proxy for the incidence of the reform in a given industry. Here again we find substantial variation in the data. For instance, while the non-metallic mineral goods industry was employing 60% of their workers above 44 hours, technical services were only employing 18% in 1988. These overtime workers were mostly formal (between 80% and 90%). After the constitutional reform, there was a substantial reduction in above 44 hours week in all industries indicating the strong reallocation effect of the policy. Panel (b) of figure 5 plots the pre-reform share of share of workers working above 44 hours against changes in informality. It suggests that, unconditionally, the numeraire effect dominates, with industries with more pre-reform overtime showing a reduction in informal share.

Firing Costs: As has been observed in the literature, increases in firing costs reduce both entry and exit and hence have ambiguous effects on formal employment (See for example, Kugler 2004). Raising the costs of firing a worker reduces formal sector. However, it also increases the cost of formal separations thereby decreasing the relative outflows from formal jobs.

Since the penalty firms have to pay upon dismissal is proportional to the wage of worker and the time the worker has spent in the firm, we are able to exploit the variation of the increase in firing costs, F_m, across industries. On average, industry *m* faces firing costs of,

$$F_m = \rho T_m \overline{w_{f,m}} \varepsilon \tag{7}$$

where ε is the share of the gross wage that gets accumulated into the FTGS (8%), $w_{f,m}$ is the average formal wage in industry *m*, ρ is the penalty imposed by the government for unjustified dismissal and T_m is the average years of tenure of formal workers in the industry. As noted, the constitutional reform engineered a fourfold increase in ρ from 10% to 40%. This increase applied equally across sectors. Since the relevant firing cost must be standardize by the productivity of the worker being dismissed and hence wages, we exploit the only remaining source of variation across industries, the pre-reform variation in average tenure, T_m. We expect that industries with higher tenure will face higher penalties for dismissal and hence are more likely to be affected by the change in the penalty fee, ρ. In particular, we use the average pre-reform tenure of fired formal workers at the industry level as our source of variation. Intuitively, we argue that those industries that, on average, fire workers at with longer tenure, after the constitutional reform, faced significantly higher prices to do so.

Consistent with this discussion, panel (b) of figure 5 suggests an unconditional positive relationship between average pre-reform tenure of fired formal workers, and the change in the share of informal work force between 1988 and 2000.

Unions: Finally, the degree of unionization may capture how the increased union power enhanced the bargaining position of workers and changed the incentives for firms to hire (and dismiss) formal workers. This can be shown to have a similar effect to an

increase in overtime pay: lower formal hiring, higher formal firing and overall, a lower overall formal sector. We exploit the pre-constitutional variation in the unionization rate as a proxy for how the changes in the treatment of unions differentially affected sectors. This varies from 15% in some service sectors to 40% in heavy manufacturing. Panel (b) of figure 5 suggests that unconditionally higher union density is correlated with higher levels of informality.

VI. Estimation

We investigate the relationship between informality and our policy variables by estimating

$$Y_{jt} = \alpha_t + \alpha_j + \overline{TRADE_{jt}}\beta_{TRADE} + \overline{D*CC_j}\beta_{D.CC} + u_{jt} \quad (8)$$

Where Y_{jt} represents one of three dependent variables relating to industry *j*: the share of informal workers in total labor force, which we include as a reference, and the two variables of interest, relative informal inflows, and relative informal outflows, as defined in equation (4).

The scalars α_t and α_j represents year and industry fixed effects, respectively, $\overline{TRADE_{jt}}$ is a vector containing both the log of effective tariffs and the log imports penetration as defined above. Though, in theory, the two trade variables are imperfect proxies for the same phenomenon, since we are interested in capturing as much explanatory power from the trade liberalization that might be correlated with the constitutional variables, we include them both.

The effect of the constitution is captured by the vector CC_j which contains the log of unionization, the log of average firing cost by industry (proxied by pre-reform average tenure of fired formal workers and the log of average overtime costs by industry (proxied by the pre-reform share of workers working more than 44 hours). Each variable is computed yearly for each of the 30 sectors (industrial and non industrial)

from 1983-2002 based on the PME. $\overline{D*}$ is a dummy variable with zeros up to 1988 (included) and ones thereafter.

Table 3 reports unit root tests for the various series. The Levin, Lin and Chu, and the Britung tests impose a uniform AR1 process across all panels while the Im, Pesaran and Shin, ADF and Philips Peron tests allow different panels to exhibit different dynamics. The effective tariff is borderline I(0) and import penetration appears I(1) in the constrained tests but I(0) at the 10% level where the panels are allowed independent dynamics. For our reference dependent variable, unconditional sector size, we cannot reject the presence of unit roots. Further, we find no evidence of cointegration with our explanatory variables so the reference specifications with these variables are under some suspicion of spurious regression. However, with the exception of the PP test (the least appropriate to our sample), for the two dependent variables on which our inference and simulations are based, the relative outflows and inflows series, are I(0).[10] Algebraically, it is straightforward to show that the combination of two I(0) series can generate the I(1) properties of the aggregate series. Though our analysis is focused on these flows, we report the results for the size variable for reference purposes, fully cognizant of the unreliability of the standard errors.

Our estimation strategy is twofold. As a first cut, we begin with a simple static specification. The first three columns of Table 4 present OLS estimations and suggest that both the trade variables and our proxies of constitutional reform played a role in increasing the share of informality by increasing relative inflows into informality (import penetration, firing costs, unionization) and decreasing the relative outflows of informality (import penetration and unionization). Consistent with the unconditioned correlations plotted in figure 5 sectors with higher shares of overtime workers show smaller increases in informality after 1988.

However, these estimates are subject to Bertrand et al.'s (2004) critique of the validity of the standard errors in situations where the observations across time on either side of the discontinuity cannot be taken as independent. Since our constitutional variables are not continuous, but depend on the cross sectional variation across the

[10] The PP test is best suited to longer t panels and hence is the least appropriate here.

discontinuity at 1988, this is a concern. We pursue two different approaches to correct for this. First, closely following Bertrand et al. (2004) we abstract from the time dimension of the data and average the observations pre-1988 and post 1988. The results are presented in the second three columns of table 4. As expected, the standard errors increase substantially, although though the point estimates are not substantially altered compared to the OLS results. We now find no significant impact of trade liberalization in the shaping of informality trends during the 1990s, consistent with Goldberg and Pavcnik (2003). In contrast, we still find significant effects of the constitutional variables albeit with somewhat lower levels of significance. Both a rise in firing costs and unionization increase the share of informality. While both firing costs and unionization increase relative informal hiring, only the prevalence of unions seem to have generated lower (higher) relative outflows from informality (formality). Restrictions on overtime, continue to lower the share of the workforce in informality (albeit only marginally significantly) through increased relative informal outflows.

The second approach allows for dynamics in the model by introducing the lagged dependent variable which is our preferred specification for several reasons. First, it allows for a more realistic modeling of the adjustment process. Second, it increases the number of observations usable in the regression while controlling for serial correlation across observations that would bias the standard errors. Third, it more efficiently uses the information from the continuous trade protection which is lost in the previous specification. We estimate a GMM system estimation model using internal instruments for the lagged depending variable. In particular, following Arellano and Bover (1995) we use lagged levels of the dependent variable dated t_{-2} and earlier as instruments for the equations in first-differences and lagged first-differences of the dependent variable as instruments for equations in levels.

The dynamic specifications are shown in columns (7) to (9) of table 4. The very significant and large coefficient on the lagged dependent variable suggests the importance of its inclusion. Further the test statistics for second order serial correlation reject the presence of serial correlation in the differenced residual in all three cases increasing our confidence in the reliability of the standard errors and the validity of the internal instruments. Overall, the results are broadly the same as those in columns (4) to (6). The short run coefficients confirm the roles of the firing costs and unionization

variables. We now find that the overtime variable enters as a factor that increases (decreases) inflows to informality (formality) and the counterintuitive finding on relative outflows disappears. This suggests that previous results were potentially capturing serial correlation and hence were inconsistent. We now do find effects of the tariff variable on the size of the informal sector. However, again, we are not entirely confident of these standard errors due to the non-stationarity of the series and because the estimates from the two stationary flows series suggests no effect. The bottom panel of the table presents the long run coefficients and the joint measures of their significance. The results remain largely unchanged although the magnitudes are only a third to one half compared to the previous exercise

In all, we find very little evidence that trade liberalization played a major role in shaping informality trends in the 90s. However, the constitutional variables appear consistently significant in our regressions. Importantly, as in Paes de Barros and Corseuil (2004), we find no impact of higher firing costs on relative outflows. However, we do find an increase in relative inflows into informality consistent with a fall in formal hiring suggesting that this heretofore unexamined hiring channel is important.

Robustness checks

Tables 5 report a series of additional robustness checks of our main results for our preferred dynamic specification. First, we revisit Goldberg and Pavcnik's (2003) concern that changes in the composition of the workforce are partly driving the trend. For instance, if formalization is related to educational attainment of the labor force, the observed rise in average years of education of workers rose across this period from 6.23 to 8.68 may change the propensity of workers to become formal. Though we do not postulate a reason why such shifts should be correlated with our covariates, we repeat the analysis controlling for shifts in observable worker characteristics by including a set of gender and education dummies as well as age and age squared. None of these controls enter significantly. Overall, the results stand.

Second, ideally, we would have a control of firms unaffected by both reforms to ensure that the variation in our variables is not picking up other effects, most notably the aggregate movements in the economy that might have affected high exposure and low exposure industries differently. To approximate this, we rerun our exercise over an arguably similar period, the 1982-83 recessions and the subsequent expansion. In this case we set the dummies underlying the proxies for CC equal to 0 for the period prior to 1985, a time in the cycle similar to that where the constitution was approved, and 1 for the three years after. The second panel of both tables shows that none of the variables in the specification emerge significantly with the exception of the overtime variable which enters weakly in the suspect aggregate size regression, Our proxies do not appear to be picking up any systematic correlations with periods of high or low growth.

Third, thus far, in the interest of explaining the overall increase in informality we have included the entire sector, both informal salaried workers and the self employed. The third panel of table 5 removes the self-employed from the sample focusing only on the salaried sector. We obtain very similar results for the informal salaried alone in both orders of magnitude of the coefficients and degree of significance.

Another confounding factor determining hiring/firing decisions at the sector level is the evolution of sector productivity. However, for two reasons we do not include a proxy in our main specifications. First, several of the reforms are thought to have impacts through productivity and hence, we do not want to short circuit those effects by controlling for them. Second, the relevant measure of formal sector productivity should be complemented by the equivalent in the informal sector data which does not exist. Hence the inclusion of an overall sectoral output variable should be seen as a rough proxy for shared cyclical fluctuations that may be correlated with our proxies. The results of including a sectoral output varialble are shown in column four.[11] The results do not change. Finally, we rerun the regression without weighting by sector size. Again, the results do not change.

[11] For industry we use the annual average quantum (produced quantity index) from the Monthly Industrial Survey of Physical Production (PIM-PF=Pesquisa Industrial Mensal de Produção Física IBGE). For services, we use the National Accounts data (IBGE and SIDRA). The National Account system only details cross sectional variation for sectors 700,701,702,703; for the rest we use GDP recorded under "Other services."

It is possible that sectors with less formal flexibility in the face of trade liberalization may have recurred more to informal employment. Alternatively, those sectors that were most affected by constitutional reforms would have found themselves affected more if they faced high or increasing competition from abroad. In Table 6, we interact each one of our three constitutional variables with the two trade variables. We find statistically significant interactions between firing costs and tariffs, and between overtime pay and import penetration for both the overall size of the sector and for relative inflows. A consistent effect is found on the relative outflows side that firms more affected by overtime legislation increased their relative outflows with trade liberalization. Hence, there is some evidence that the two reforms taken together exacerbated the impact on informality that either would have had separately or if they had been designed to be complementary. However, as we show below quantitatively, trade reforms can explain little of the overall change in informality.

In sum, the impact of the constitutional variables appears robust to a variety of specification changes.

VII. Explaining the Rise in Informality

We can now use our preferred estimates in table 4 to ask how much each of the two sets of reforms analyzed in this paper may explain the increase in informal employment. We generate the counterfactual increases in the share of informal employment, relative informal inflows and relative formal outflows had imports and tariffs remained at its level in 1988 (in the absence of trade) and, second, had the constitution not being approved (in the absence of constitution).

Table 7 shows this exercise for our preferred dynamic specification in results from this exercise.[12] The first row shows the actual trends from 1988 to 2002 for the size, relative inflows and relative outflows from informality. The share of informality over total employment increased by 0.90 percentage points a year, while the relative inflows into informality increased by 2.6 percentage points a year and the relative

[12] Very similar quantitative results are obtained if instead we use the estimates of tables 5 and 6.

outflows from informality decreased by 3.4 percentage points a year. The next rows present the counterfactual changes in these three variables accounting for the effects of the reforms. We find that, had the trade reforms not taken place the relative inflows into informality would have increased by only 0.8% less, and relative outflows by 0.23%. By contrast, the constitutional reforms can explain up to 52% of the relative increase in inflows into informality although as expected, substantially less of relative outflows. The coefficients on the size variables suggest that trade can explain 1.2% and the constitution 43% of the increase. However, given our concerns about the non stationarity of this variable, we also present the simulated impacts on the steady state levels of informality using the counterfactual predictions of the relative flows and their contributions to changes in the level of informality from table 2. We find that around 39% of the changes in the steady state level of informality can be attributed to the constitutional reform and less than 1% to trade. The changes occur, essentially, through changes in the hiring patterns of firms. The results show that trade can actually explain very little of any of the dynamics we observe in the data. The effect of the constitutional reforms again, on within sector informality, is sizeable.

Two sources of healthy skepticism have emerged about these results. First, Kucera and Roncolato (2008) argue that both real wages and unionization experienced falls across the period of magnitudes that potentially dwarf the cost implications of the constitutional reforms. On the first count, when the correct deflator is used (see Corseuil and Fogel 2002), real wages average roughly the same level in the pre- and post-reform periods.[13] On the second count, our calculations with the PNAD confirm the findings from others that union density indeed fell across the period (see, for example, Arbache 2004) and this presumably led to a decrease of indeterminate magnitude in the bite of the reforms. That said, our estimates rely on the variance of union density across sectors and this was preserved: the overall decline occurred remarkably uniformly leading to a correlation of the 1984 and 1999 sectoral densities of .93 and a rank correlation of .92. Hence, the pre-reform values of unionization that we use are well-correlated with ongoing cross-sectoral variation in union power, and are unaffected by

[13] The official CPI implies a dramatic increase in real wages across the post reform period, a phenomenon discussed by Chamon (1998). However, Corseuil and Fogel (2002) argue that the official CPI series badly understates inflation in 1994 due to mishandling the coexistence of the Real and the Cruzeiro in that year. When their deflator is used and correctly centered in the series, the real wage, while showing some volatility, is roughly equal in the pre and post reform periods.

the reforms which is precisely what we need for consistent estimation. Hence neither concern weakens our results.

The second concern is that 2000s witnessed a significant recovery of formality despite the persistence of the reforms above and, in fact, a sustained rise in the minimum wage. Though falling outside of the coverage of our panel and analysis, this evolution merits a brief comment.

First, the central fact about this period is the sustained expansion of roughly 5% after 2004. Informality is highly responsive to the business cycle and hence, raw comparisons of its evolution across periods might be misleading. Bosch and Maloney (2008) show the cyclical formal employment elasticity of 0.5 with respect to the cyclical component of output and we may expect the long run elasticity to be somewhat larger. Since this elasticity is effectively conditional on extant labor distortions, this implies a secular increase in the formal sector of at least 2.5% per year.

Second, kernel density plots (available on request) confirm that, indeed, the minimum wage became increasingly binding from 2002 to 2010. However, there are reasons to believe that this is consistent with the observed rise in formality. First, as has been found in other studies, [14] the minimum wage is often more binding in the informal sector than the formal sector, leaving some ambiguity about the degree to which relative wages have moved against formal employment for low wage workers. Second, Lemos (2009) finds no impact of the minimum wage on employment, although Neumark, Cunningham, and Siga (2005), more pessimistically, find that an increase that binds an additional 10% of the workforce reduces employment of household heads by 1.56 percentage points, with no or positive impact on non-household heads.[15] The rise from 13% to 17% bound from 2002 to 2010 would therefore lead to a maximum of 2.5

[14] This "efeito farol" or lighthouse effect where norms in the informal sector are set in the formal has been documented earlier in the Brazilian case by Souza and Baltar (1979), Neri, Gonzaga and Comargo (2000), and Latin America more generally by Maloney and Nuñez (2001).

[15] Second, much of rise represents catch up from declines across the post reform period (see Lemos 2009). We find that the share of workers at the minimum wage in 2010 is 17%, up from 8% in 1998, but not so far above the 15% in the immediate post reform (1990-1994) period. Hence, viewed as an extension of our previous analysis, the net change in the minimum wage from the beginning of the reforms to the present is relatively small.

percentage points (assuming that half of the formal employed are household heads) decrease in formality, a fraction of our minimum estimate of the rise caused by growth.

Other possible explanations

In the simulations above, the trade variables with substantial variation explain around 1% of the secular movements in informality. The constitutional reform is able to explain around 40%. Ideally, we might have more time series variation that could concretely rule out other possible phenomena not related to labor market legislation. We briefly review two possible candidates.

First, along with the Constitutional reforms affecting labor markets were initiatives changing the nature of health system implemented in the early 1990s that granted universal access to health services.[16] Carneiro and Henley (2003) suggest that uncovered employment may have risen because employees and employers collude to avoid costly contributions to a social protection system that is perceived to be inappropriate, inefficient and poor value for the money.[17] In principle, then, a universalization of health care de-linked from the labor market may have changed the cost-benefit analysis of being enrolled in, and hence contributing to, formal sector benefits programs. In the end, they conclude that this is unlikely, not only because public health services continued to be thought of as substantially worse than the formal sector product,[18] but also because the effective supply of these services was available even for non contributors several years before the reforms took place: As early as 1981

[16] Among the changes contemplated in the Social Security System Reform of 1991 (which comprises pensions, health, and social aid), health related amendments are the only candidates to be considered as possibly determinants. Although pensions reforms loosened the requirements to perceive a pension (age for eligibility and required years of services were lowered) and increased the benefits of recipients (see De Carvalho (2002) for a summary of the characteristics of the Brazilian security system before and after the reform), two reasons reduce its suitability to explain the composition and dynamics of the labor market: first, benefits are computed as a function of documented past earnings over the cumulated time of services except for those perceiving the minimum pensions hence in any of those cases there is no incentive for workers to move between formality or informality because of potential gains in switching due to pensions; second, the reforms should have exerted more effects over the elder population close to retirement which is not the critic mass driving the size and dynamics of the labor sectors.

[17] Their estimates suggest that the earnings premium needed in the marketplace to compensate covered workers for having to make social security contributions varies between 7.5% and 12.2% of the mean uncovered hourly wage.

[18] The public system acts as a floor, available to all but used primarily by the lower classes (Jack (2000)). Although evaluation of standards for minimum quality in infrastructure, human resources, ethical, technical and scientific procedures in hospitals have been implemented, these practices are far from being universal in the services network, PAHO (2005).

roughly 49% of self employed and 59% of the informal salaried compared to 48% of the formal salaried report that they received attention from a public health provider.[19] Further, little progress had been made on implementing the measures contemplated in the 1991 Social Security Reform.

Second, there was an increase in the magnitude of flows from the rural to the urban areas across the 1990s that, in principle, were it all directed toward the informal sector, might explain part of the rise.[20] Table 8 suggests that this is not the case. Panel (a) shows that the PNAD survey, which covers the entire population, yields very similar formal and informal sector shares when the sample is restricted to the metropolitan area to those of the PME.[21] This cross check suggests that our two surveys are telling very consistent stories. The PNAD also shows that the rural sector is far less formal and hence the idea that migration to the city might lead to urban informalization is plausible.[22] However, panels (b) and (c) show that, while there was substantial rural to urban migration across the period, this did not map into a large shift in metropolitan-non metropolitan shares of population or of the work force. For the 1990-2001 period, the employed rural work force contracted by 19% (2 million workers) while the urban growth rate rose 40%. However growth rate of the metropolitan and non-metropolitan areas was a very similar 25% and 29% respectively reflecting far small reallocations. Even under the extreme and unsupportable assumption that those 2 million rural workers who moved to urban areas were informal and had migrated exclusively to metropolitan areas (which are a subset of urban areas), they could explain at most half of the 4 million observed increase of the informal. Further, this would imply no increase in the number of informal workers in the non-metropolitan areas which actually rose from 20 to 27 million as can be inferred from panels (a) and (c). In short, most of the rise in informality must be due to reallocation of labor within geographical sub regions.

[19] PNAD 1981. Non urban dwellers excluded.

[20] See Ramos and Ferreira (2005a,b) for a comprehensive description of the regional patterns of the Brazilian workforce.

[21] A Metropolitan Region is a group of specific limiting municipalities. By Constitutional prerogative, such a group is defined by each specific State of the country with the purpose of improving the planning and the execution of public functions of common interest. As a point of reference, according to PNAD, about 97% of the population and of the employed workforce older than 15 years living in Metropolitan Regions is classified as Urban.

[22] Dwellers are classified either as Urban or Rural according to the geographical location of their residences. A residence is classified as Urban if it is located on a city (municipal level), on a village (distrital level) or in isolated urban areas. A residence is classified as Rural if it is located outside the aforementioned locations.

VIII. Conclusions

This paper has sought to explain the dramatic rise in the size of the informal sector over the decade of the 1990s by studying the impact of trade and constitutional reforms on gross labor flows. We establish that trade liberalization played a relatively small part in this increase, but find suggestive evidence that several dimensions of the constitutional reform, in particular, regulations relating to firing costs, overtime, and union power, explain much more. Both effects work mostly through the reduction in hiring rates, rather than separation rates that have been investigated most in the literature to date. Overall, the findings confirm the importance of labor legislation to firms' decisions to create new formal sector jobs in Brazil.

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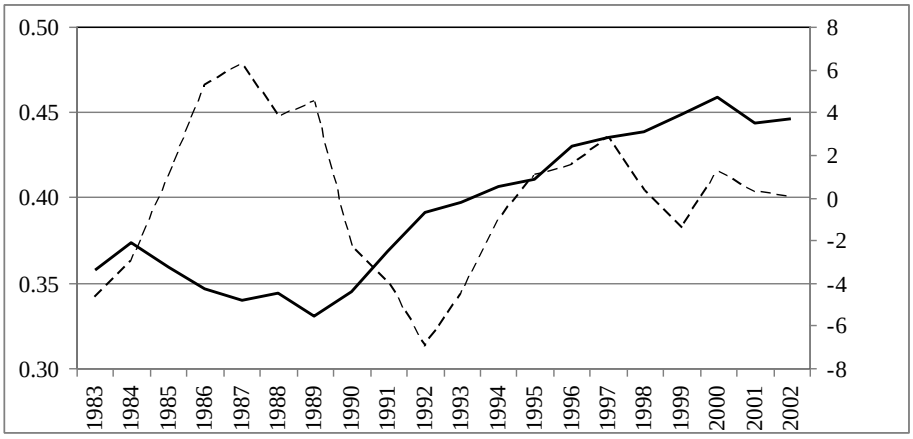
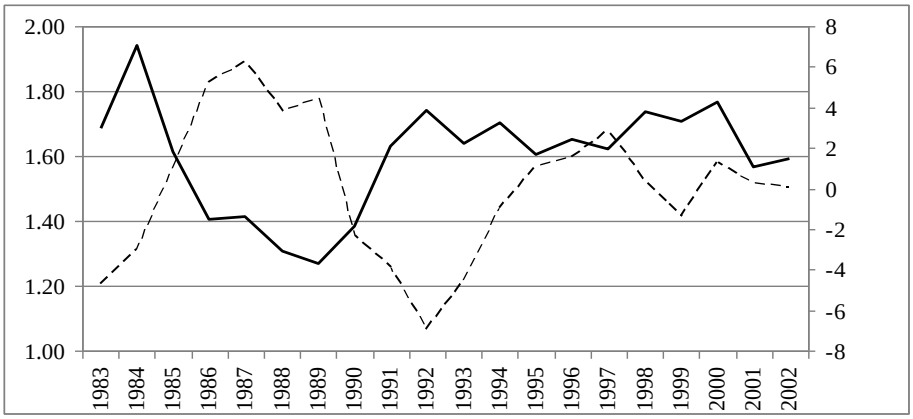
Figure 1: Size and Relative Informality Flows: Brazil 1983-2002

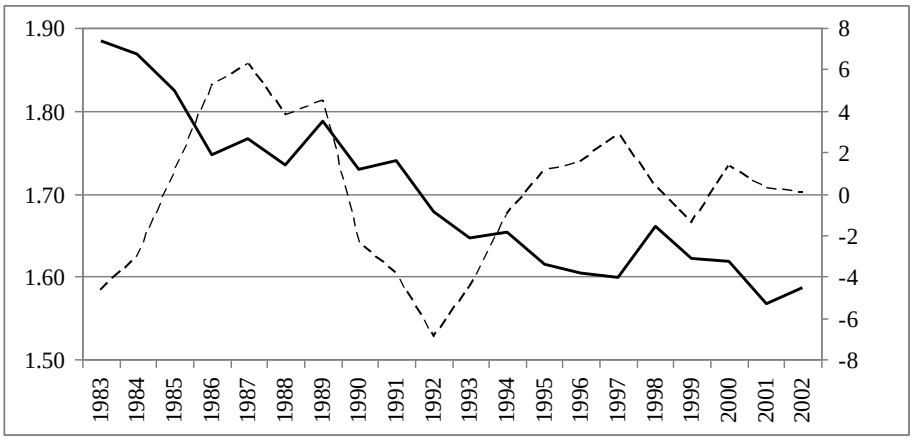
Size of the Informal Sector



Relative Inflows to Informality

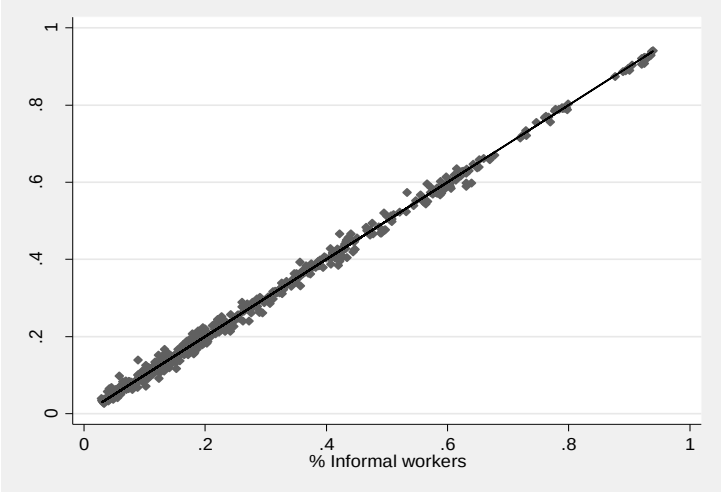


Relative Outflows from Informality



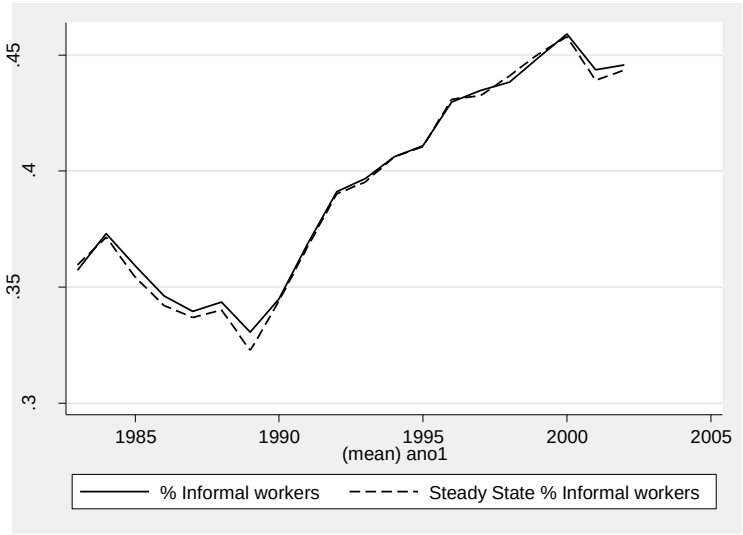
Notes: The dash line represents the HP detrended Brazilian log GDP (right axis). The solid (left axis) lines represent the values of the size of the informal sector, the relative inflows and the relative outflows to and from informality for the overall country.

Figure 2a: Steady State Informality by Industry



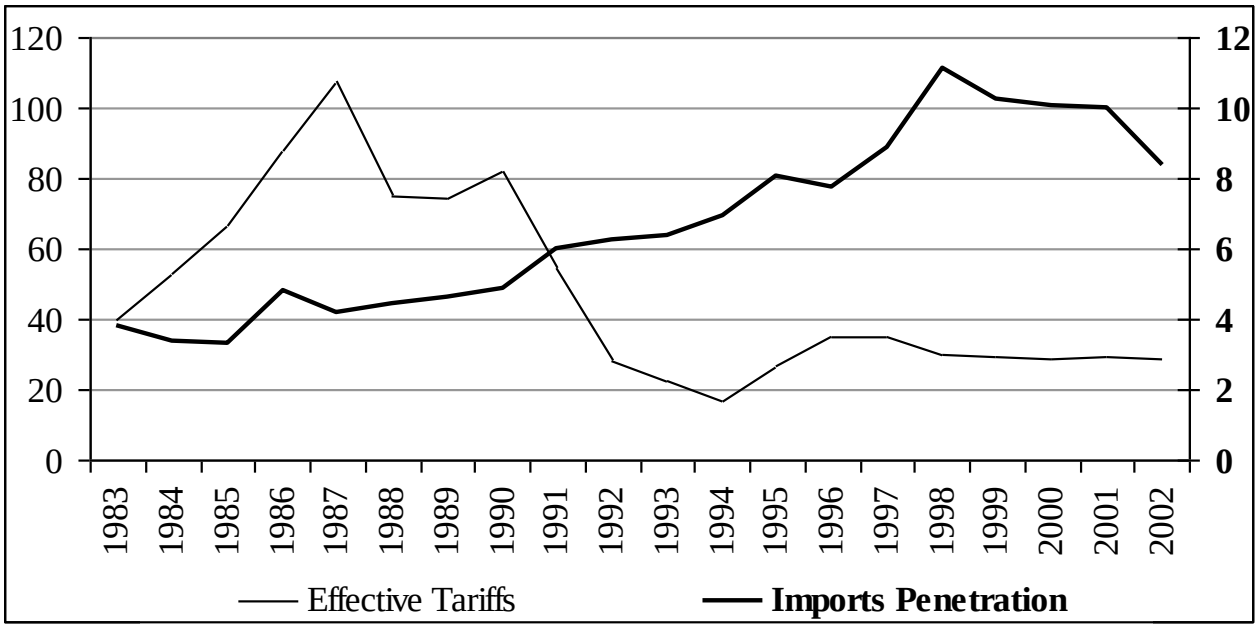
Notes: The figure shows the actual % of Informal workers by sectors and its steady state valued calculated from inflows and outflows of worker according to equation () for all years. The solid line is a 45 degree line.

Figure 2b : Steady State Informality 1983-2002



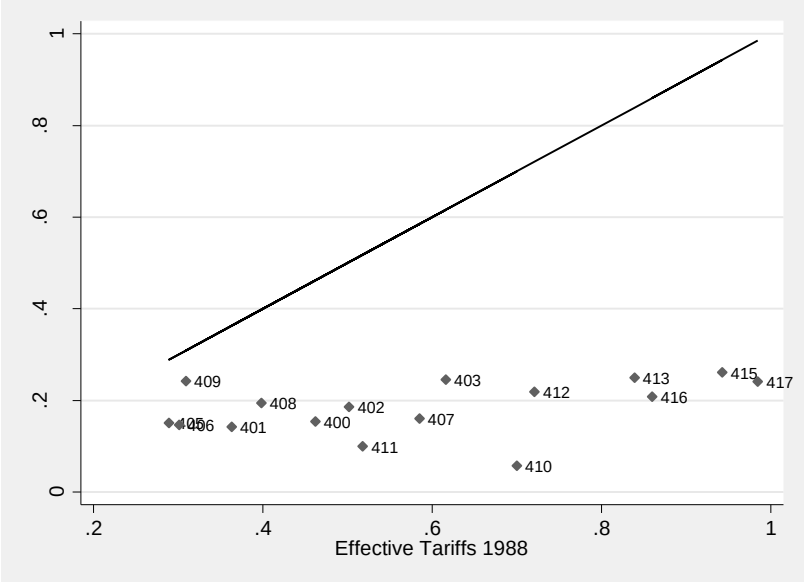
Notes: The figure shows the evolution of the actual series of the % of informal workers and its steady state valued calculated from inflows and outflows of workers. The steady state value is computed by calculating the steady state of each sector year cell according to equation (5) and averaging across years using employment weights.

Figure 3: Effective Tariff Protection and Import Penetration



Note: Figures correspond to weighted averages of all industrial sectors (with weights given by the size of each industrial sector). Tariffs (left axis) are obtained from Kume et al. (2003) for 1987-1998; Pinheiro and Bacha de Almeida (1994) for 1983-1986. Imports penetration (right axis) corresponds to weighted imports/consumption by industry and are obtained from Muendler (2002) for 1987-1999; Pinheiro and Bacha de Almeida (1994) for 1983-1986; Nassif and Pimentel (2004) for 1999-2002.

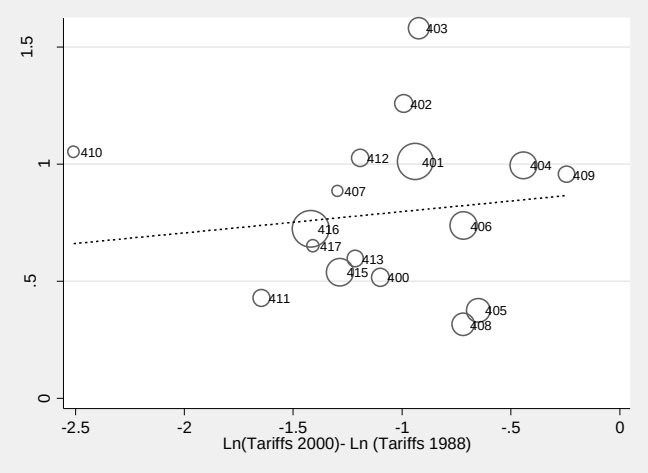
Figure 4 : Effective Tariff 1988 and 2000 by Industry



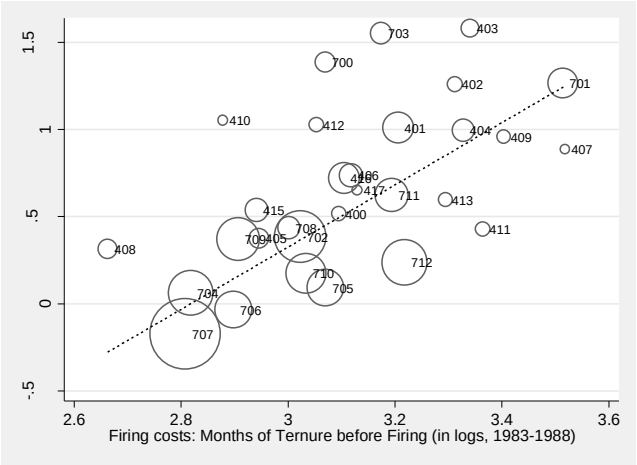
Note:The figure shows the Effective Tariffs in 1988 vs Tariffs in 2000. The solid line is a 45 degree line. Tariffs are obtained from Kume et al. (2003) for 1987-1998; Pinheiro and Bacha de Almeida (1994) for 1983-1986

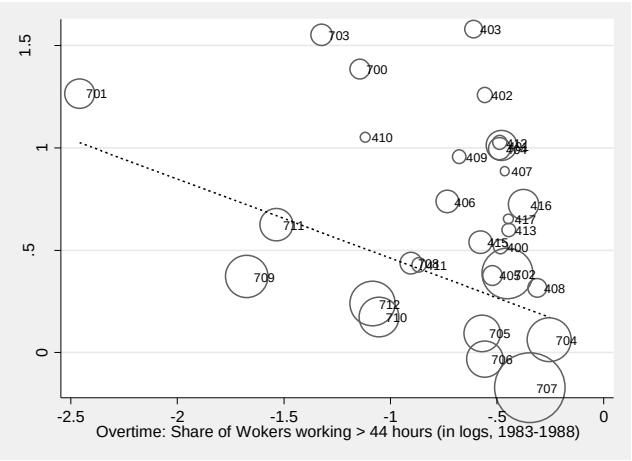
Figure 5: Unconditioned Correlations

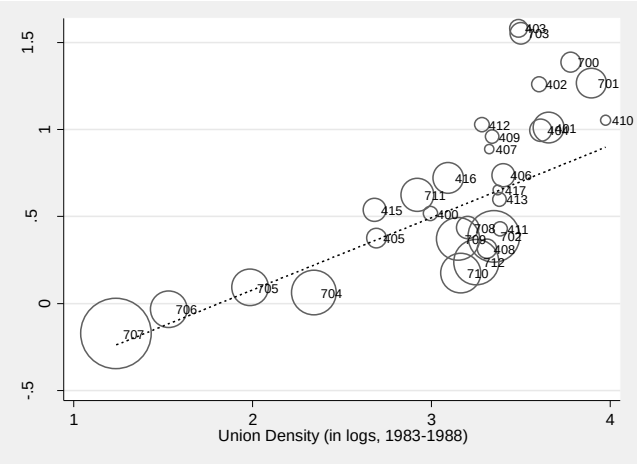
Panel (a): Trade Variables vs. Size of the Informal Sector



Panel (b): Constitutional Change Variables vs. Size of the Informal Sector







Notes: The graphs plot the changes in the share of informal workers from 1988-2000 against our 5 policy variables. Bubbles' sizes reflect the relative size of the particular sector (in terms of workers). See table 1 for sector definitions.

Table 1: Changes in Informality by sector 1983-1988 and 1988-2002

		Informality Share				Employment Share			
		1983	2002	Change 1983-1988	Change 1988-2002	1983	2002	Change 1983-1988	Change 1988-2000
Code	**All sectors**	**0.36**	**0.45**	**-1.37**	**10.21**	**1.00**	**1.00**	**-**	**-**
	Manufacturing	**0.14**	**0.30**	**0.09**	**16.29**	**0.32**	**0.22**	**0.96**	**-10.16**
400	Nonmetallic Mineral Goods	0.16	0.26	-0.79	10.56	0.02	0.01	-0.17	-0.54
401	Metallic Mineral Goods	0.12	0.32	-0.57	20.05	0.04	0.03	0.34	-1.22
402	Machinery and Equipment	0.06	0.22	0.66	15.60	0.02	0.01	0.09	-1.22
403	Electrical and Electronic Equipment and Components	0.05	0.26	0.14	20.30	0.02	0.01	0.13	-0.96
404	Vehicle and Vehicle Parts	0.04	0.10	-0.11	6.35	0.03	0.02	0.35	-1.26
405	Wood Sawing, Wood Products and Furniture	0.41	0.64	3.27	20.03	0.02	0.01	-0.07	-0.28
406	Paper Manufacturing, Publishing and Printing	0.14	0.31	0.79	16.00	0.02	0.02	-0.09	-0.33
407	Rubber	0.06	0.13	-0.32	7.76	0.00	0.00	0.06	-0.23
408	Footwear and Leather and Hide Products	0.19	0.27	0.50	7.37	0.02	0.01	-0.03	-1.01
409	Non petrochemical Chemicals	0.06	0.14	-0.61	8.43	0.01	0.01	0.19	-0.86
410	Petroleum Refining and Petrochemical	0.04	0.09	-0.46	5.90	0.01	0.00	0.07	-0.23
411	Pharmaceutical Products, Perfumes and Detergents	0.13	0.19	-0.35	6.57	0.01	0.01	-0.05	-0.04
412	Plastics	0.07	0.19	-0.49	12.48	0.01	0.01	0.16	-0.24
413	Textiles	0.10	0.20	1.19	8.82	0.02	0.01	0.04	-1.12
415	Apparel and apparel accessories	0.26	0.49	2.24	20.37	0.03	0.02	0.08	-0.82
416	Food	0.17	0.37	0.69	19.20	0.03	0.03	-0.12	0.42
417	Beverages	0.05	0.09	-0.55	4.26	0.01	0.00	-0.04	-0.21
	Services	**0.46**	**0.50**	**-1.62**	**6.22**	**0.68**	**0.78**	**-0.96**	**10.16**
700	Distribution of Water	0.05	0.20	0.07	15.17	0.02	0.01	-0.18	-0.58
701	Banking and Insurance	0.04	0.20	1.84	14.33	0.06	0.03	-0.78	-2.26
702	Transportation	0.36	0.47	-4.30	15.01	0.09	0.10	-0.43	1.04
703	Postal Services, Phones	0.03	0.18	0.73	14.34	0.01	0.02	-0.05	0.48
704	Lodging	0.58	0.60	-1.05	3.67	0.05	0.07	0.60	1.24
705	Repairs	0.76	0.79	-4.01	6.99	0.04	0.05	0.44	0.44
706	Clothing	0.92	0.89	0.04	-3.08	0.05	0.05	-0.57	0.34
707	Domestic workers	0.66	0.52	-4.03	-9.81	0.18	0.18	-1.56	1.51
708	Artistic, Radio	0.40	0.65	2.51	23.07	0.01	0.02	0.11	0.94
709	Technical	0.42	0.60	-0.41	18.59	0.04	0.07	0.58	2.43
710	Auxiliary	0.31	0.41	3.37	6.63	0.03	0.06	0.58	2.47
711	Social Services	0.22	0.41	0.53	19.25	0.04	0.04	-0.04	-0.19
712	Doctors	0.16	0.22	0.91	4.67	0.05	0.07	0.34	2.30

Notes: The table shows the changes in employment and informality shares by sector.

Table 2: Contributions of the Relative Inflows and Outflows into Steady State Informality Rate

		Relative Inflows		Relative Outflows		Steady State		Contribution of RI	Contribution of RO
		1988	2002	1988	2002	1988	2002	1988-2002	1988-2002
Code	**All sectors**	**1.22**	**1.59**	**1.75**	**1.58**	**0.41**	**0.50**	**0.76**	**0.24**
	Manufacturing								
400	Nonmetallic Mineral Goods	0.44	0.65	2.48	2.02	0.15	0.24	0.72	0.28
401	Metallic Mineral Goods	0.26	0.56	1.87	1.46	0.12	0.28	0.83	0.17
402	Machinery and Equipment	0.13	0.36	2.07	1.29	0.06	0.22	0.82	0.18
403	Electrical and Electronic Equipment and Components	0.15	0.60	2.75	1.57	0.05	0.28	0.88	0.12
404	Vehicle and Vehicle Parts	0.10	0.23	2.87	2.05	0.03	0.10	0.81	0.19
405	Wood Sawing, Wood Products and Furniture	1.18	2.23	1.46	1.39	0.45	0.62	0.95	0.05
406	Paper Manufacturing, Publishing and Printing	0.48	0.86	3.10	2.42	0.14	0.26	0.78	0.22
407	Rubber	0.14	0.30	2.68	2.43	0.05	0.11	0.93	0.07
408	Footwear and Leather and Hide Products	0.83	0.84	3.65	3.61	0.19	0.19	0.49	0.51
409	Non petrochemical Chemicals	0.15	0.29	2.58	1.80	0.05	0.14	0.75	0.25
410	Petroleum Refining and Petrochemical	0.06	0.19	1.87	1.70	0.03	0.10	0.96	0.04
411	Pharmaceutical Products, Perfumes and Detergents	0.29	0.61	2.41	2.22	0.11	0.21	0.93	0.07
412	Plastics	0.16	0.41	2.46	1.75	0.06	0.19	0.84	0.16
413	Textiles	0.37	0.62	3.01	2.19	0.11	0.22	0.71	0.29
415	Apparel and apparel accessories	0.77	1.63	2.00	1.67	0.28	0.49	0.87	0.13
416	Food	0.50	1.24	2.72	1.95	0.16	0.39	0.84	0.16
417	Beverages	0.17	0.18	3.50	1.81	0.05	0.09	0.11	0.89
	Services								
700	Distribution of Water	0.31	0.58	4.78	1.72	0.06	0.25	0.57	0.43
701	Banking and Insurance	0.28	0.69	4.69	2.67	0.06	0.20	0.77	0.23
702	Transportation	0.21	0.43	1.90	1.77	0.10	0.20	0.94	0.06
703	Postal Services, Phones	0.87	1.55	5.70	2.48	0.13	0.38	0.58	0.42
704	Lodging	2.50	2.58	2.05	1.92	0.55	0.57	0.31	0.69
705	Repairs	2.24	3.01	0.89	0.90	0.71	0.77	1.03	-0.03
706	Clothing	8.22	6.61	0.83	0.95	0.91	0.87	0.57	0.43
707	Domestic workers	2.13	1.90	1.30	1.88	0.62	0.50	0.19	0.81
708	Artistic, Radio	1.69	2.59	1.94	1.46	0.47	0.64	0.68	0.32
709	Technical	0.86	1.59	1.25	1.14	0.41	0.58	0.91	0.09
710	Auxiliary	0.62	0.75	1.17	1.21	0.35	0.38	1.17	-0.17
711	Social Services	0.61	1.16	2.26	1.67	0.21	0.41	0.78	0.22
712	Doctors	0.48	0.60	2.22	2.01	0.18	0.23	0.72	0.28

Notes:

The table shows the contributions of relative inflows and outflows in the steady state informality level by industry.

Table 3: Unit Root Tests

	Sector Size	Relative Inflows	Relative Outflows	Effective Tariff	Imports Penetration	GDP
Null: Unit root (assumes common unit root process)						
Levin, Lin & Chu t	0.11	0.01	0.00	0.07	0.29	0.00
Breitung t-stat	0.16	0.02	0.00	0.00	0.87	0.37
Null: Unit root (assumes individual unit root process)						
Im, Pesaran and Shin W-stat	0.16	0.00	0.00	0.05	0.07	0.00
ADF - Fisher Chi-square	0.26	0.02	0.00	0.05	0.07	0.00
PP - Fisher Chi-square	0.98	0.17	0.00	0.18	0.28	0.00

Notes: The table shows the p-values of the respective tests.

Table 4. Effects of the Trade Liberalization and Constitutional Reforms. 1983-2002

	Baseline Specification			Ignoring Time Dimension			Dynamic Structure		
	Size	Relative Inflows	Relative Outflows	Size	Relative Inflows	Relative Outflows	Size	Relative Inflows	Relative Outflows
Trade Liberalization									
Tariffs	-0.030	-0.017	-0.002	-0.035	0.028	0.013	-0.012**	-0.008	0.001
	(0.019)	(0.019)	(0.011)	(0.121)	(0.095)	(0.052)	(0.005)	(0.005)	(0.005)
Import Penetration	0.110***	0.103***	-0.055***	0.056	0.092	-0.019	-0.008	-0.005	0.003
	(0.022)	(0.020)	(0.013)	(0.100)	(0.101)	(0.041)	(0.012)	(0.008)	(0.006)
Constitutional Change									
Firing Costs	0.478***	0.340***	-0.084	0.532**	0.374**	-0.098	0.064**	0.059*	-0.000
	(0.096)	(0.081)	(0.068)	(0.210)	(0.172)	(0.125)	(0.031)	(0.033)	(0.040)
Unions	0.191***	0.182***	-0.155***	0.195***	0.188***	-0.157***	0.018**	0.020**	-0.013
	(0.025)	(0.023)	(0.019)	(0.040)	(0.031)	(0.037)	(0.008)	(0.008)	(0.010)
Overtime	-0.221***	-0.063*	0.161***	-0.198*	-0.036	0.154***	-0.003	0.015*	0.008
	(0.044)	(0.035)	(0.030)	(0.097)	(0.059)	(0.050)	(0.013)	(0.008)	(0.018)
Lagged Dependent Variable							0.824***	0.683***	0.597***
							(0.047)	(0.044)	(0.030)
Long Run Effects									
Tariffs							-0.068**	-0.025	0.002
							[0.035]	[0.016]	[0.011]
Import Penetration							-0.045	-0.016	0.007
							[0.070]	[0.024]	[0.014]
Constitutional Change									
Firing Costs							0.362**	0.185*	-0.001
							[0.178]	[0.105]	[0.097]
Unions							0.101**	0.063**	-0.032
							[0.051]	[0.026]	[0.026]
Overtime							-0.018	0.047*	0.021
							[0.077]	[0.027]	[0.044]
First Order (p-value)							0	0	0
Second Order (p-value)							0.712	0.611	0.15
R2	0.644	0.664	0.497	0.870	0.895	0.826	0.936	0.873	0.763
Observations	600	600	600	60	60	60	540	540	540

* significant at 10%; ** significant at 5%; *** significant at 1%

Notes: Sector size corresponds to the share of informal (I) workers (both informal salaried and self-employed) in an specific industry. Relative Inflows and outflows correspond to the new informal entries and exist into and from a particular industry relative to formal (entries and exits) according to equation (19). All pooled by year. Imports penetration corresponds to weighted imports/consumption by industry Firing costs corresponds to a dummy variable (active since 1989) interacted with the pre-treatment tenure (log of average months 1983-1988) of workers fired in the specific industrial sector. Unions correspond to a dummy variable (active since 1989) interacted with union enrollment - understood as % of unionized workers in the specific industrial sector (log of average 1986 and 1988). Overtime corresponds to a dummy variable (active since 1989) interacted with the proportion of workers working more than 44 hours in the specific industrial sector (log of average 1983-1987). The Baseline specification includes all years and industries (number of observations 600: 30 industries x 15 years). Ignoring time dimesions estimations takes average of all varibles before and after the constitional reform (number of observations 60: 30 industries x 2 time periods). Standard errors are clustered at the industry level. The Dynamics espcificaiton shows a GMM system estimator using lagged levels of the dependent variable dated $t-2$ and earlier as instruments for the equations in first-differences and lagged first-differences of the dependent variable as instruments for equations in levels, as suggested by Arellano and Bover (1995). In all dynamic estimations the Sargan Test cannot reject the exogeneity of the internal instruments.

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Table 5: Robustness Checks: Dynamic Structure

	Controlling by Human Capital			Placebo Law pre 1988			Only Informal Salaried			Including Sectorial Output			Unweighted		
	Size	Relative Inflows	Relative Outflows	Size	Relative Inflows	Relative Outflows	Size	Relative Inflows	Relative Outflows	Size	Relative Inflows	Relative Outflows	Size	Relative Inflows	Relative Outflows
Trade Liberalization															
Tariffs	-0.013**	-0.008	0.002	0.010	0.003	0.001	-0.007	-0.005	0.001	-0.010**	-0.008	-0.000	-0.012**	-0.008	0.001
	(0.006)	(0.005)	(0.005)	(0.012)	(0.016)	(0.013)	(0.005)	(0.006)	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)
Import Penetration	-0.006	-0.003	-0.001	-0.061*	-0.020	-0.000	-0.007	-0.008	-0.001	-0.011	-0.005	0.003	-0.008	-0.005	0.003
	(0.012)	(0.010)	(0.005)	(0.035)	(0.014)	(0.011)	(0.010)	(0.006)	(0.005)	(0.013)	(0.008)	(0.006)	(0.012)	(0.008)	(0.006)
Constitutional Change															
Firing Costs	0.065**	0.062**	0.001	-0.007	0.001	0.002	0.040	0.024	-0.005	0.057*	0.059*	0.001	0.064**	0.059*	-0.000
	(0.031)	(0.030)	(0.028)	(0.005)	(0.002)	(0.001)	(0.030)	(0.024)	(0.034)	(0.034)	(0.034)	(0.044)	(0.031)	(0.033)	(0.040)
Unions	0.015	0.015**	-0.008	-0.052	-0.035	-0.020	0.023**	0.014**	-0.006	0.016*	0.020**	-0.012	0.018**	0.020**	-0.013
	(0.009)	(0.007)	(0.012)	(0.050)	(0.025)	(0.023)	(0.011)	(0.007)	(0.012)	(0.009)	(0.008)	(0.011)	(0.008)	(0.008)	(0.010)
Overtime	0.004	0.020*	0.002	0.027	-0.017	0.043*	-0.002	0.004	0.010	0.000	0.015*	0.007	-0.003	0.015*	0.008
	(0.018)	(0.011)	(0.022)	(0.051)	(0.016)	(0.022)	(0.012)	(0.007)	(0.015)	(0.017)	(0.009)	(0.019)	(0.013)	(0.008)	(0.018)
Sectoral Output										-0.052	-0.007	0.029			
										(0.037)	(0.035)	(0.021)			
Lagged Dependent Variable	0.825***	0.688***	0.612***	0.656***	0.749***	0.521***	0.773***	0.613***	0.584***	0.814***	0.683***	0.593***	0.824***	0.683***	0.597***
	(0.047)	(0.043)	(0.030)	(0.091)	(0.087)	(0.109)	(0.055)	(0.047)	(0.038)	(0.046)	(0.044)	(0.030)	(0.047)	(0.044)	(0.030)
Human Capital															
Primary Education	-0.016	-0.009	0.013												
	(0.014)	(0.019)	(0.016)												
Secondary Education	-0.005	0.002	-0.007												
	(0.007)	(0.009)	(0.006)												
Age	0.303	0.271	-0.356												
	(0.222)	(0.344)	(0.230)												
Age2	-0.131	-0.164	0.146												
	(0.110)	(0.164)	(0.094)												
First Order (p-value)	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0
Second Order (p-value)	0.75	0.60	0.096	-	-	-	0.678	0.108	0.091	0.734	0.612	0.102	0.717	0.611	0.08
Observations	540	540	540	90	90	90	540	540	540	540	540	540	540	540	540
R2				0.961	0.934	0.892	0.925	0.853	0.753	0.936	0.874	0.763	0.912	0.820	0.659
				0.942	0.903	0.842	0.917	0.838	0.728	0.929	0.860	0.738	0.903	0.801	0.624

* significant at 10%; ** significant at 5%; *** significant at 1%

Notes: In all estimations the Sargan Test cannot reject the exogeneity of the internal instruments. See also notes in table 3 and 4.

Table 6: Trade and Constitutional Interactions

		Dynamic	
	Size	Relative Inflows	Relative Outflows
Trade Liberalization			
Tariffs	0.005	-0.017	-0.002
	(0.010)	(0.016)	(0.017)
Import Penetration	-0.029	-0.012	0.008
	(0.018)	(0.011)	(0.013)
Constitutional Change			
Firing Costs	0.009	0.044	0.034
	(0.037)	(0.040)	(0.051)
Unions	0.018**	0.020**	-0.014
	(0.008)	(0.008)	(0.011)
Overtime	-0.019	0.011	0.014
	(0.014)	(0.011)	(0.017)
Interactions			
Firing Costs X Tariffs	-0.032**	-0.032*	-0.002
	(0.014)	(0.018)	(0.012)
Unions X Tariffs	0.003	0.010	-0.014
	(0.018)	(0.023)	(0.014)
Overtime X Tariffs	0.066	0.074	0.052**
	(0.050)	(0.052)	(0.024)
Firing Costs X Imp. Pent.	-0.025	-0.033	-0.020
	(0.024)	(0.029)	(0.019)
Unions X Imp. Pent.	-0.006	0.006	0.009
	(0.029)	(0.035)	(0.018)
Overtime X Imp. Pent.	0.116***	0.085*	0.017
	(0.038)	(0.046)	(0.026)
Lagged Dependent Variable	0.789***	0.678***	0.847***
	(0.049)	(0.044)	(0.061)
First Order (p-value)	0.00	0.00	0.00
Second Order (p-value)	0.99	0.60	0.15
Observations	540	540	540
R2	0.646	0.69	0.473

* significant at 10%; ** significant at 5%; *** significant at 1%

Notes: In all estimations the Sargan Test cannot reject the exogeneity of the internal instruments instruments. See also notes in table 3 and 4.

Table 7: Actual and Latent Trends

	Size	Relative Inflows	Relative Outflows	Explained Changes in SS
Actual	0.909***	2.596***	-3.467***	
	(0.092)	(0.831)	(0.190)	
Latent (in the absence of Trade)	0.898***	2.575***	-3.459***	
	(0.090)	(0.827)	(0.192)	
Explained by changes in Trade	1.2%	0.8%	0.23%	0.65%
Latent (in the absence of Constitution)	0.516**	1.250	-3.447***	
	(0.177)	(0.715)	(0.290)	
Explained by changes in the Constitution	43%	52%	0.6%	39.15%

* significant at 10%; ** significant at 5%; *** significant at 1%

Notes: The table shows the trends in the size, relative inflows and relative outflows of the informal sector. The actual coefficients are obtained from regressing the appropriate variable on a linear trend for the period 1988 to 2002. The latent trends are obtained by subtracting from the actual data the effect of either trade of constitutional variables using the dynamic specification in table 4 and then regressing the resulting series on a linear trend. The last column shows the explained changes in the steady state level of informality using the results from relative inflows and relative outflows and the estimates from table 2 on the contributions of each flow to the changes in the steady state.

Table 8a: Employment Shares by Geographical Division

Sector	Survey	Year	Urban	Rural	Metropolitan	Non-Metropolitan
Formal	PNAD	1981	57.37	18.51	65.57	38.92
	PME	1983			63.25	
Informal	PNAD	1981	42.63	81.49	34.43	61.08
	PME	1983			36.75	
Formal	PNAD	1990	54.57	26.68	61.04	42.16
	PME	1990			61.34	
Informal	PNAD	1990	45.43	73.32	38.96	57.84
	PME	1990			38.66	
Formal	PNAD	2001	46.78	20.00	51.52	38.95
	PME	2001			52.96	
Informal	PNAD	2001	53.22	80.00	48.48	61.05
	PME	2001			47.04	

Table 8b: Relative Growth Rates of Population by Geographical Division

	Survey	Year	Urban	Rural	Metropolitan	Non-Metropolitan
Millions of Inhabitants	PNAD	1981	55.12	19.56	24.81	49.87
	PNAD	1990	70.20	22.52	30.07	62.66
	PNAD	2001	102.80	18.21	39.87	81.14
Growth (in %)		1990/1981	27.36	15.17	21.19	25.64
		2001/1990	46.45	-19.16	32.61	29.51

Table 8c: Relative Growth Rates of Employed Labor Force by Geographical Division

	Survey	Year	Urban	Rural	Metropolitan	Non-Metropolitan
Millions of Workers	PNAD	1981	29.53	8.70	13.78	24.45
	PNAD	1990	40.87	11.05	17.79	34.13
	PNAD	2001	57.26	8.93	22.22	43.97
Growth (in %)		1990/1981	38.38	27.09	29.10	39.60
		2001/1990	40.11	-19.22	24.86	28.84

Notes: The figures consider to individuals above 15 years of age only. PNAD has national coverage. PME covers 6 major metropolitan areas only, but has a panel dimension. Panel (a) shows that both surveys yield similar employment shares by in metropolitan areas. Panel (b) shows that, while there is clearly rural/urban migration this does not translate to substantial non-metropolitan to metropolitan shifts. Panel (c) is the counterpart of (b) for the employed labor force.

APPENDIX I : AN ILLUSTRATIVE MODEL

As a way of organizing thinking on the impacts on gross flows of the innovations discussed above, we build a highly stylized search and matching model of interactions between the formal and informal sector. We assume that firms can hire workers under two production technologies. The first is suitable for relatively low productivity workers and is difficult to monitor by the government. Getting the most out of intrinsically more productive workers requires, however, a technology that is easier to monitor by the government and hence the firm must comply with all regulations and make the worker formal. We might think of subcontracting jobs that are able to be done at home, or that are simply not very visible compared to work that involves specialized machinery and a fixed location or plant. The model focuses on the hiring and firing decision of firms, as they are confronted with high and lower productivity applicants and their decision at the margin between choosing formal or informal labor.

Let *V* be the present discounted value (PDV) for a firm of the expected profit from posting a vacancy. The total number of matches between firms and workers, *m*, is given by the matching technology *m=m(u,v)*, where *u* and *v* represent the number of unemployed workers and vacancies respectively. Firms find workers at an average rate $q(\theta) = m/v$, where θ the vacancy to unemployment ratio (v/u) is. Similarly, workers find firms at an average rate of $\theta q(\theta) = m/u$

We assume that once the firm and the worker have met, the firm observes the true idiosyncratic productivity of the match, x.which is drawn randomly from a known c.d.f. $G(x)$. Given x, the firm decides to hire the worker formally or informally. Here we greatly simplify the decision by assuming that only formal workers can take advantage of the idiosyncratic productivity of the match. If the firm hires the worker formally the productivity of the match is given by $p_f x$ where p_f is an overall productivity parameter for formal jobs. If, instead the firm uses an informal contract the match produces p_i, independently of the value of x. This mechanism generates that, consistent with the data, the most productive matches give rise to formal contracts. $J_f(x)$ and J_i represent the PDV for the firm of occupied formal and informal jobs respectively. It is straightforward, then, to show that there is a reservation productivity x_f that will make the firm indifferent between hiring the worker formally or informally. Hence, we can write the flow value of a vacant job for the firm as

$$rV = -c + q(\theta)\left[\int_{x_f}^{x^{\max}} (J_f(x) - V)dG(x) + G(x_f)(J_i - V)\right], \tag{A1}$$

where *r* is the interest rate, *c* is the instantaneous cost of keeping the vacancy open. Similarly, the value for the firm of occupied formal and informal jobs can be expressed as

$$rJ_i = p_i - w_i - \lambda_i(J_i - V) \tag{A2}$$

$$rJ_f(x) = p_f x - w_f - \eta h + \int_{x_d}^{x^{\max}} [J_f(s) - J_f(x)]dG(s) - \lambda_f G(x_d)(J_f(x) + F - V) \tag{A3}$$

The production technology of informal workers is very simple. A worker hired produces p_i in an exchange for w_i. Exogenous shocks arrive to informal jobs at rate λ_i at which point the match is destroyed.

Formal firms have to abide by labor codes, so that, on top of the wage w_f, they have to pay an overtime premium η, in case they have to work over the legal maximum hours per week. This excess in hours is represented by *h*, which is considered exogenous in the model. The last two terms of equation (A3) capture the continuation value of the job. We assume that ongoing formal jobs are subject to idiosyncratic productivity shocks a la Mortensen and Pissardes (1994) that modify the productivity of the match. These shocks arrive at rate λ_f. However, in this case the jobs are not automatically destroyed. Upon the arrival of a shock, a new value for x is drawn from $G(x)$. The matches are only destroyed if the new productivity value renders the match unprofitable. Let this idiosyncratic productivity be x_d. If the new productivity is above x_d the match persists. If is below x_d the firm destroys the relationship paying firing costs *F*.

The workers problem is similar to that of the firm. The present discounted value of unemployment, U, can be written as

$$rU = b + \theta q(\theta)\left[\int_{x_f}^{x^{\max}} (W_f(x) - U)dG(x) + G(x_f)(W_i - U)\right] \tag{A4}$$

where *b* is the flow of income when unemployed, $\theta q(\theta) = m(u,v)/u$ is the rate at which workers meet firms, and $W_f(x)$ and W_i are the present discounted value for the worker of a formal and informal job respectively. Again, the contract will be formal if the idiosyncratic productivity is above x_f. Once the contract is signed the worker enjoys $w_f(x)$ or w_i depending on whether the contract is formal or informal, until the job is destroyed endogenously for formal workers or exogenously for informal ones.[23]

$$rW_i = w_i + \lambda_i(U - W_i) \tag{A5}$$

$$rW_f(x) = w_f(x) + \int_{x_d}^{x^{\max}} [W_f(s) - W_f(x)]dG(s) - \lambda_f G(x_d)(W_f - U) \tag{A6}$$

As is standard in the literature, wages in this model maximize the joint surplus and determine the following sharing rules for formal and informal jobs.[24]

$$J_f(x) - V + F = \frac{1-\beta}{\beta}(W_f(x) - U) \tag{A7}$$

$$J_i = \frac{1-\beta}{\beta}(W_i - U)$$

where β is the workers bargaining power.[25] Using this sharing rule and equations (A1) to (A6) we can obtain the two wage equations for formal and informal jobs respectively,

[23] Note, that neither overtime pay, ηh, of firing costs, F, accrue to the value of a formal job for the worker. This is due to the nature of wage negotiation in this framework. Since firm and worker share the surplus of the match any transfer between the two parties will not have an impact in equilibrium. This is standard in the literature, see Pissarides (2000).

[24] It can be argued that the initial bargaining rule should not consider firing cost in the threat point of the firm since they are still not operational. This would give rise to two different wage equations for formal workers. This variation leaves the results qualitatively unchanged.

$$w_f(x) = (1-\beta)b + \beta p_f(x + \theta c + rF - \eta h) \quad \text{(A8)}$$
$$w_i = (1-\beta)b + \beta p_i(1 + \theta c)$$

In this framework the equilibrium of the model must satisfy three conditions that determine our three endogenous variables; how many vacancies to post (which would determine θ) when to hire a formal worker (x_f) and when to fire formal worker (x_d). As usual in search and matching models, the free entry condition determines that there cannot be any profitable opportunities from vacancy posting, hence $V = 0$. Second, optimal hiring of formal workers must satisfy that the firm is indifferent between hiring the marginal worker formally or informally, that is $J_f(x_f) = J_i$. Finally, optimal firing of workers must satisfy that the reservation productivity x_d makes the formal job unprofitable. This happens when $J_f(x_d) + F = 0$

Using equations (A1) to (A8) and our three equilibrium conditions we obtain the three equilibrium equations in the model;

Free entry

$$\frac{c}{q(\theta)} = (1-\beta)\left[\int_{x_f}^{x\max}\left(\frac{p_f(x - x_d)}{r + \lambda_f}\right) - \frac{F}{1-\beta}\right)dG(s) + G(x_f)\frac{p_i - b - \frac{\beta}{1-\beta}\theta c}{r + \lambda_i}\right] \quad \text{(A9)}$$

Optimal Hiring

$$p_f x_f = p_f x_d + \frac{(r + \lambda_f)F}{1-\beta} + \frac{(r + \lambda_f)}{(r + \lambda_i)}\left[p_i - b - \frac{\beta}{1-\beta}\theta c\right] \quad \text{(A10)}$$

Optimal Firing

$$p_f x_d = b + \frac{\beta}{1-\beta}\theta c + \eta h - rF - \frac{\lambda_f}{(r + \lambda_f)}\int_{x_d}^{x\max} p_f(s - x_d)dG(s) \quad \text{(A11)}$$

It is straight forward to show that the equilibrium in this model exists and it is unique (see appendix II for details).

With knowledge of θ, x_f, and x_d we can derive the evolution stock of workers. Formal employment, n_f, is determined by the law of motion

$$\dot{n}_f = \theta q(\theta)(1 - G(x_f))u - \lambda_f G(x_d)n_f \quad \text{(A12)}$$

Similarly, informal employment follows the law of motion

$$\dot{n}_i = \theta q(\theta)G(x_f)u - \lambda_i n_i \quad \text{(A13)}$$

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[25] One could argue that the bargaining power of formal and informal workers, β, is different. This has no consequences in the model.

Normalizing the labor force to one, unemployment is given by,

$$u = 1 - n_f - n_i \tag{A14}$$

.

The share of informal employment, is given by

$i = \frac{n_i}{n_f + n_i}$, which can also be written as $i = \frac{\gamma}{1+\gamma}$, where $\gamma = \frac{n_i}{n_f}$. From, equations (12) and (13) we obtain the steady state value of γ as,

$$\gamma = \frac{G(x_f)}{1 - G(x_f)} \frac{\lambda_f G(x_d)}{\lambda_i} \tag{A15}$$

.

Equation (A15) states that the share of informal employment in the model is a composite of the relative inflows into informality ($\frac{G(x_f)}{1-G(x_f)}$), and the relative outflows from informality $\frac{\lambda_i}{\lambda_f G(x_d)}$. These, along with the sectoral shares, are the dependent variables whose movements we seek to explain below.

The equilibrium of the model is determined by free entry, optimal hiring and optimal hiring conditions. These determine the three equilibrium equations in our model (equations (9) to (11)) which we reproduce here.

Free entry

$$\frac{c}{q(\theta)} = (1-\beta)\left[\int_{x_f}^{x\max} \left(\frac{p_f(x - x_d)}{r + \lambda_f}\right) - \frac{F}{1-\beta}\right) dG(s) + G(x_f) \frac{p_i - b - \frac{\beta}{1-\beta}\theta c}{r + \lambda_i}\right] \tag{A16}$$

Optimal Hiring

$$p_f x_f = p_f x_d + \frac{(r+\lambda_f)F}{1-\beta} + \frac{(r+\lambda_f)}{(r+\lambda_i)}\left[p_i - b - \frac{\beta}{1-\beta}\theta c\right] \tag{A17}$$

Optimal Firing

$$p_f x_d = b + \frac{\beta}{1-\beta}\theta c + \eta h - rF - \frac{\lambda_f}{(r+\lambda_f)} \int_{x_d}^{x\max} p_f(s - x_d) dG(s) \tag{A18}$$

It is straightforward to show the existence and uniqueness of the equilibrium in this model. Higher θ, increases the left hand side of the free entry condition since more vacancies per unemployed increases waiting time for firms and hence the expected cost of posting a vacancy. Furthermore, it lowers the right hand side this same equation since the formal separation threshold in equilibrium (x_d) depends positively on θ. Note that in equilibrium, the formal/informal threshold, x_f, does not alter the expected profits from

posting a vacancy due to in the virtue of the envelope condition it satisfies $J_f(x_f) = J_i$ Hence, there is a unique value of θ that satisfies equation the free entry condition.

Effects of policies

Trade liberalization: We model trade liberalization simply as a change in the relative productivity of the formal sector relative to the informal. On the one hand, lower barriers increase the competition that an industry, and reduces the wedge between formal and informal productivity (formal sector rents) within an industry (for a given p_i, p_f decreases). This shifts hiring towards informal labor (increase in x_f) and increases the threshold of separations in the formal sector (increase in x_d). Both effects generate a reduction in the share of formal employment formal sector. However, in a contrary effect, reducing tariffs and quotas also permits greater access to imported capital goods and other intermediate inputs that may increase relative formal sector producivity.

Firing Costs: Raising the costs of firing a worker enters into the overall cost calculation in a manner similar to that of the overtime pay and shifts hiring from formal to informal employment (higher x_f). However, in this case the increased cost of formal separation decreases the relative outflows from formal jobs (lower x_d). As has been observed in the literature this implies that increases in firing costs, by reducing both entry and exit, have ambiguous effects on formal employment (See Kugler 2004).

Overtime Pay: Our model suggests that that an increase in the overtime pay (η) will reduce demand for formal labor. This translates into a reduced formal hiring relative to informal hiring, higher x_f, and an increase in the relative separation from formal jobs, higher x_d. Both forces imply a reduction in the share of formal employment. Further, we argue that the impact will be greater in those industries where the use of overtime (prior to the reform) was greater, greater *h* in the model. Hence, we expect that industries with a higher share of their working hours above the post constitutional maximum hours a week would see the greatest impact.

It is important to note that while our model captures the depressive effect of increased costs on formal labor demand there may a countervailing numeraire effect: Though total

hours worked by formal workers may fall, the fewer hours that each employee may legally work implies that the number of workers may actually rise. Determining the net effect requires knowledge of the number of overtime hours, the cost imposed by the overtime legislation, and especially the elasticity of formal/informal labor demand, two out of three of which we do not know.[26]

Unions: Finally, the degree of unionization may capture how the increased union power enhanced the bargaining position of workers and changed the incentives for firms to hire (and dismiss) formal workers. This effect is captured in the model by the parameter β. We can show that an increase in β, under some regularity conditions (that the elasticity of the matching function with respect to unemployment is equal to β), has a similar effect to an increase in overtime pay: lower formal hiring, higher formal firing and overall, a lower overall formal sector.

[26] Simiarly as on of the refereees noted the effects of overtime pay in this model depend on the multiplicative nature of ηh. Different formulations would not necessarily yield the same results.