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"SOURCES OF PAYMENTS PRACTICES RIGIDITY"

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ABSTRACT: This paper studies the joint determination of the wage payments period between firms and employees. The aggregate time-series analysis reaches two conclusions: a) the average payments period keep an equilibrium relationship with the previous inflation peak, this indicates some degree of irreversibility payments practices. b) the low previous inflation peak elasticity of average payments periods reveals a high degree of rigidity of payments practices.

The framework developed in the paper incorporates the following sources of payments practices rigidity: a) interactions between optimal payments period decisions and optimal number of trips to the bank. b) the occurrence of Pareto inefficiencies in the bargaining process between firms and employees due to wage regulation. c) integer restrictions on payments frequencies produced by upper bounds on the payments period. The empirical part of the paper assesses the relevance of these different sources of payments practices rigidity using Brazilian micro data.

SOURCES OF PAYMENTS PRACTICES RIGIDITY

Marcelo Neri¹

1- INTRODUCTION

This paper studies the determination of wage payments practices during high inflation. The empirical analysis is done with household data from the six main Brazilian metropolitan regions. Figure 1 presents the evolution of different payments frequencies among employees from 1982 to 1993.

The modest change of payments periods despite increasing inflation rates (see figure 2), contrasts with Barro's (1970) predictions. In Barro's model, the payments period function approaches an inflation elasticity of $-1/2$ as the rate of inflation becomes large. Since Barro's model assumed away transactions between money and bonds, the introduction of an extra margin of substitution between these assets should reduce payments period role as a mechanism designed to economize on cash balances². In the opposite extreme of Barro's model is

¹ From UFF and PNPE/IPEA. This paper is part of an on going Ph.D. thesis at Princeton University. I have benefited from discussions with Orley Ashenfelter, Ben Bernanke, David Card and Dean Hyslop. All remaining errors are my own.

² In Barro's model, the choice of wage payments frequency involves a tradeoff between higher cash inventories and higher transaction costs. If inflation rises, the increase in foregone interest motivates firms and employees to transact more frequently so receipts and expenditures become more synchronized and cash holdings fall.

Baumol's (1952) textbook model where payments periods are given and bonds stocks are the sole flight from money channel. Neri (1995) does a series of comparative tests on the predictions of Barro and Baumol's models using Brazilian data. The empirical analysis favored Baumol's model predictions, indicating that payments periods are somewhat rigid. The present paper takes this analysis one step further, estimating the elasticity of average payments period with respect to inflation and assessing possible sources of payments practices rigidity in the recent Brazilian experience.

The paper builds a model that studies the joint determination of the wage payments period between firms and workers. The framework developed nests Barro and Baumol's models as special cases. The main advantage of this integrated approach is to allow for interactions between optimal payments period and optimal bond holdings in firms and employees decisions. The model incorporates a menu of possible causes for the apparent rigidity of employees payments practices observed in Brazil during the last fifteen years. The relevance of the different sources of payments practices rigidity are later assessed with micro data.

The first source of payments practices rigidity analyzed here is the availability of interest-bearing assets that provide a less costly way to economize on cash balances than changes in payments periods. However, this is clearly an incomplete story, since as we show later a significant fraction of Brazilian households do not own short-run interest-bearing assets. The model developed later shows that when just workers do not own these assets, the elasticity of payments practices with respect to the inflation rate is identical to the one found when firms and workers do not own these assets. As inflation rises, exchanges of more frequent payments for lower wage levels

between firms and employees are used to satisfy the demand of workers for more frequent payments.

The realistic case for an elasticity of payments period with respect to inflation close to zero must include as well some source of rigidity in the bargaining process between firms and workers. With that in mind, I impose a binding wage floor in the model trying to capture the imposition of a minimum wage and of compulsory indexation schemes present in the recent Brazilian experience. In the context where exchanges between payments periods and wages are not allowed and consequently Pareto optimal outcomes cannot be reached, payments periods are rigid and the size of the inefficiency introduced by binding wage floors increases with inflation.

Finally, corner solutions generated by the Brazilian Wage Law (ie., nominal wage rigidity and upper bounds on the payments period) provide a complementary explanation for the lack of payments practices flexibility found in the Brazilian case.

The paper is organized as follows: The second section develops the basic framework of analysis. The next three sections study possible sources of payments period rigidity by extending this basic framework in different directions. The third section studies the influences of interest-bearing assets on payments periods decisions. The first part of section 4 analyzes the interaction between an asymmetric asset structure between firms and workers and wage rigidity on payments period decisions, as a determinant of payments practices rigidity. The second part of section 4 study the effects of nominal wage rigidity and lower bounds on payments frequencies. The fifth section study aggregating effects of integer restrictions on payments frequency. The sixth section generates some aggregate time-series evidence on the inflation elasticity of payments periods. The following section assesses empirically

the relative importance of each source of payments period rigidity studied in sections three, four and five using micro data. The last section concludes.

2. THE MODEL

The model developed in this section study the joint determination of the payments period between firms and employees using a deterministic inventory approach. The model extends Barro's (1970) model in three respects. First, it incorporates interactions between optimal payments period decisions and optimal number of trips to the bank. Second, the model study the occurrence of Pareto inefficiencies in the bargaining process between firms and employees due to wage regulation. Finally, the model incorporates integer restrictions on payments frequencies due to upper bounds on payments periods.

A. HOUSEHOLD UNITS

Consider a representative household that earns its income and conducts its expenditures at a uniform rate Y . Since income payments are costly, they are received at discrete intervals of size $(T/p)_I$, where T is the length of some arbitrary planning horizon (eg. one year) and p is the number of payment's periods. The unit sets its expenditure rate to exhaust its reserves just prior to the next lumpy receipt of funds. It can be shown that an optimal solution requires equally spaced wage payments of equal size. Payments can either be anticipated or deferred. That is, either firms finance employees or employees finance firms³. In the former case, the initial debt of employees to firms is YT/p , and employees steadily reduce their indebtedness over the

³ In general, either the complete anticipation or the complete deferral of payments correspond to the optimal solution (see footnote 6).

payment period to a null level just before the next payment, so average debt holdings are $YT/2p$. Similarly if employees are creditors, then the size of the wage credit with firms gradually increases from zero to YT/p during the payment period. So the average wage credit of employees is also $YT/2p$.

During each payment interval of length T/p , the unit will hold financial reserves either as cash or bonds. After receiving payment, households are required to go to the bank to allocate YT/p of initial reserves between money and bonds. This implies that the minimum number of bank trips is one ($f \geq 0$). If the household decides to hold bonds, the optimal solution requires $(f+1)$ equally spaced bank trips. In the first bank trip the unit buys $(f/f+1)(YT/p)$ in bonds and, in the following f trips it cashes in these bonds. Just after the bank trip the unit keeps $(1 - (f/f+1))(YT/p)$ in cash that will be uniformly spent until next bank trip. Therefore, average money holdings correspond to $YT/(2p(f+1))$ and average bond holdings correspond to $(1 - 1/(f+1))(YT/2p)$. From the above discussion the expressions for average stocks of different financial instruments are:

$$W = \frac{Y T}{2 p} ; B = \frac{Y T}{2 p} \left(1 - \frac{1}{f+1}\right) ; M = \frac{Y T}{2 p}$$

Where:

Y = expenditure flow

W = average Wage debt of workers (firm

$\frac{T}{p}$ = payments period

B = average Bond holdings

M = average Money holdings

BM = average Broad Money holdings

c_p = Cost of receiving Payments the fir

f = extra number of bank trips

(1)

The expressions above result from the following assumptions: a) uniformity of expenditures flows; b) equally spaced payments; c) equally spaced financial transactions. These expressions show that higher income and a longer payment period increase the debt of firms with workers, bond holdings and cash holdings. The second expression implies a positive relation between the frequency of bank trips ($f+1$) and average bond holdings. Finally, the third expression implies an inverse relation between the frequency of financial transactions and average cash holdings.

The household unit problem amounts to deciding the frequency of cash receipts to maximize financial profits. There are two tradeoffs involved: a) more frequent payments may decrease financial losses involving average debt (credit) holdings with firms at the expense of higher transactions costs; b) more frequent bank trips may decrease financial losses involving average cash holdings but it increases transaction costs. The profit function of households is:

$$FP = W r_c T + B r_b T + M r_m T - p c_p - p f c_b$$

where:

r_c = rate of Return on wage Credit (debt)

r_b = rate of Return on Bonds

r_m = rate of Return on Money

c_p = Cost of receiving Payments the firm

f = bond selling Frequency per payment period

c_b = transaction Cost $M \rightarrow B$

(2)

Substituting expression (1) for the average asset holdings into the profit function expression (2) and simplifying:

$$FP = - \frac{Y T^2}{2 p} \left[c_d - r_b + \frac{r_b - r_m}{f+1} \right] - p c_p - p f c_b \quad (3)$$

ie. $c_d = -r_d$

c_d = Cost rate of wage Debt (credit)

Employees financial profit depends on the payments period (T/p), the frequency of financial transactions (f+1), and exogenous variables. The maximization of employees financial profit function (3) implicitly assumes that employers are indifferent to payments periods. Since Pareto-optimal payments period decisions also depend on employers' costs, the problem posed above should not be solved in isolation.

B. FIRMS DECISIONS:

Consider now a representative firm that receives its proceeds at a constant rate. Transfers from firms to productive factors and financial assets involve lumpy transaction costs and are conducted at discrete intervals. At each payment interval the unit exhausts all its financial reserves. Firms reserves are held either as cash or bonds. Transaction costs, income and prices grow at the same rate so each transfer is evenly spaced. The representative firm's problem amounts to decide the payments period and the number of bank trips in this interval. The tradeoff involved is that more frequent transfers to production factors and/or to interest-bearing assets may raise firms' financial return but at the same time they increase transaction costs.

If labor is the only productive factor, the employer's

problem turns out to be the mirror image of the employee's problem posed above. Firms' revenue flows correspond to employees expenditure flows, while firms' expenditures correspond to employees' wage receipts. Finally, the firms wage bill debt corresponds to their employees' credit. This symmetry property leads to an isomorphism between the average financial instruments holdings expressions for employers and employees. Equation (3) also corresponds to the firm's financial profit function to be maximized⁴.

C. THE JOINT DETERMINATION OF THE WAGE PAYMENTS PERIOD

In principle, the determination of wage payments practices depends on both employers and employees decisions. The problem can be posed in terms of the maximization of their total financial profits (TFP)⁵:

$$TFP = -\frac{YT^2}{2p} \left[c_d^n - r_b^w - r_b^f + \frac{r_b^w - r_m^w}{f^w + 1} + \frac{r_b^f - r_m^f}{f^f + 1} \right] - p(c_p^w + c_p^f + f^w c_b^w + f^f c_b^f)$$

$$ie., c_d^n = c_d^w + c_c^f$$

(4)

Clarifying the notation used above, variables without superscripts are common to both types of agents. This refers either to common exogenous variables (eg. Y) or joint decision

⁴ Barro (1970) derived step by step the financial cost function faced by firms and showed, in a model without intermediary stable assets, the isomorphism between firms and workers problem.

⁵ The inclusion of other assets besides cash and bonds in the basic inventory theoretical approach yields similar insights as the model presented below.

variables (eg. T/p). The w and f superscripts indicate the agent the variable refers to (ie. workers or firms). Finally, the superscript n refers to the value after adding workers and employees variable. It applies here to the net cost of wage debt (c_d^n).

The proportion of wage payments that are deferred or anticipated depends on the least costly wage debt (credit) arrangement (ie. the lowest c_d^n). c_d^n depends on the relative position between firms and workers of borrowing rates (b) and lending rates (l) with respect to their respective psychological discount rates (d). After transfers between workers and firms cancel out, there remains a net cost to be minimized⁶. In general, firms have better collateral than workers. So one would expect firms to be less subject to financial market imperfections and to face lower borrowing rates. If subjective discount rates and lending rates are homogeneous between firms and workers then a net borrowing condition for firms at all times is the least costly arrangement⁷.

The first-order condition for the maximum of the joint maximization problem (4) yields:

$$\left(\frac{T}{p}\right)^* = \sqrt{\frac{2 (c_p^w + c_p^f + f^f c_b^w + f^w c_b^f)}{Y (c_w^n - r_b^w - r_b^f + \frac{r_b^w - r_m^w}{f^w + 1} + \frac{r_b^f - r_m^f}{f^f + 1})}} \quad (5)$$

⁶ The optimal c_d^n corresponds to $\min[(b - d), (d - l)]$. Intermediary solutions are dominated by either total payments anticipation or total payments deferral so the problem amounts to finding the optimal identity of the borrower.

⁷ Work incentive reasons may also induce firms to defer payments.

$$(f^i + 1)^* = \left(\frac{T}{P}\right) \sqrt{\frac{Y (r_b^i - r_m^i)}{2 c_b^i}} \text{ where: } i=f, w \quad (6)$$

The completion of the analysis requires the specification of transaction costs and the rate of return on available assets and debts for firms and households. For simplicity, I will assume that the rate of return on bonds, the rate of return on cash and the unit cost of bank trips are identical between firms and workers (ie. $r_b = r_b^w = r_b^f$; $r_m = r_m^w = r_m^f$ and $c_b = c_b^w = c_b^f$). Cash holdings yield a null nominal return so its real rate of return corresponds to minus the inflation rate.

Solving the system of simultaneous equations (5) and (6):

THE BENCHMARK CASE

$$\left(\frac{T}{P}\right)^* = \sqrt{\frac{2 (c_p^w + c_p^f - 2 c_b)}{Y (c_d^n - 2 r_b)}} \quad (7)$$

$$(f^i + 1)^* = \sqrt{\frac{(c_p^i - c_b) (r_b + \pi)}{c_b (c_d^n - r_b)}} \quad (8)$$

π = inflation rate

Equation (8) shows that a higher differential between payments costs and bond transaction costs lowers the number of bank trips undertaken by workers and firms (ie., $i = f, w$), while an increase in nominal interest rates produces the opposite result. Higher net costs of deferred payments relative to the rate of return on bonds reduce the number of trips to the banks.

Equation (7) states that a higher differential between total payments cost for firms and workers with respect to the cost of going to the bank increases the payment period while a higher differential between the total cost of deferring payments in relation to twice the rate of return on bonds produces the opposite effect. The payment period is inversely related to income levels, reflecting the operation of scale economies characteristic of the inventory theoretical approach. Perhaps more interestingly, according to (8) the payments period is not influenced by the inflation rate. In sum, equations (7) and (8) show that the rate of return on bonds affects the number of bank trips and the payments period⁸ while inflation affects only the former variable.

The solution of the system of equations (5) and (6), presented in equations (7) and (8) above assumed that: a) (T/p) and f^w and f^f can be treated as continuous variables and that

⁸ Irving Fisher (1911, pp 85), discussing the behavior of the velocity of circulation of money in the US during the XIX century, poses: "As a matter of history, however, it is not likely that the substitution *from monthly to weekly payments* has increased the rapidity of circulation of money among men fourfold because the change of another element, book credit, would be likely to cause a somewhat compensatory decrease. It is probable that workingmen, who formerly found it necessary to trade on credit, to make their own payments in cash, thus tending to decrease the velocity of turnover of money." (*italics added*). In the benchmark model bond holdings do a similar offsetting force to payments period changes, as trade credit did in Fisher's argument.

interior solutions apply, that is: $(T/p) \geq 0$, $f^w \geq 0$ and $f^f \geq 0$; b) employees and employers can freely tradeoff higher or lower wage levels for shorter or longer payment periods in order to achieve the maximum joint financial profits posed above (ie., the focus is on Pareto-optimal solutions); c) employers and employees have a similar asset structure which includes only cash and bonds. In the next three sections I will analyze the sensitivity of the payment period outcome with respect to changes in these three assumptions, using equations (7) and (8) as a benchmark case. The objective of this exercise is to explain the rigidity of employees payments intervals over the last fifteen years in Brazil.

3. ACCESS TO BONDS MARKET

A. BAUMOL and BARRO's MODELS

The system of equations (5) and (6) incorporates Barro (1970) and Baumol's (1952) models as special cases. The common restriction imposed in Baumol and Barro's model is the absence of interactions between individual equations (5) and (6).

First, keeping (T/n) fixed at all times generate a Baumol model solution for firms and employees' optimal number of bank trips:

$$(f^w + 1)^* = (f^f + 1)^* = \frac{T}{p} \sqrt{\frac{Y(i_b + \pi)}{2c_b}} \quad (9)$$

The payments period in Baumol model is fixed so it shares the same insensitivity of payments practices to inflation found in the Benchmark case. Similarly, if no economic unit is allowed to purchase bonds (that is setting f^w and f^f equal to zero),

equation (5) is equivalent to Barro's formula⁹:

$$\left(\frac{T}{P}\right)^* = \sqrt{\frac{2 c_p}{Y (c_{nd}^n + 2 \pi)}} \quad (10)$$

The comparison of equations (7) and (10) shows that the sensitivity of the payment period with respect to the inflation rate depends on how widespread bond holdings are. In the case of a well-developed market for short run assets one would expect an insensitivity of payments periods to inflation. In the other extreme represented by Barro's model, when bond holdings are in a corner solution, the elasticity of payments periods with respect to inflation would be -1/2.

B. ASYMMETRIC ACCESS TO BONDS MARKET

An intermediary case between the benchmark case (7) and Barro's model (10) is to give firms but not workers access to bond markets¹⁰. The corresponding payments period solution is:

Barro set C_d^n equal to twice employees subjective discount rates.

¹⁰ The asymmetry between firm's and worker's access to bond holdings can be explained in terms of economies of scale. In general, each firm has many workers (say n workers), so individual firms manage more resources than individual workers (ie. YT/p versus YT/np). Since the marginal benefit of an extra bank trip increases with income while the transaction cost remains constant, it is possible to show that, all else equal, there are intermediary values of bonds transactions costs where only workers are on a corner solution in the bonds market.

$$\left(\frac{T}{P}\right)^* = \sqrt{\frac{2(c_p^w + c_p^f - c_b)}{Y(c_d^n - r_b + \pi)}} \quad (11)$$

The comparison between equations (7), (10) and (11) reveals that the equilibrium payments period solution is inversely related with the proportion of agents with access to bond markets. However, the elasticity of payments period with respect to inflation is $-1/2$ in either the case one side or both sides involved in payments period determination have no access to bonds markets. This means that to produce a zero elasticity of payments periods with respect to inflation requires that both firms and workers have access to bond markets.

4. WAGE RIGIDITY

A. REAL WAGE RIGIDITY

All cases presented above result from the maximization of firms and employees' total financial profit, including interest costs and transaction costs. This joint profit maximization procedure warrants the achievement of Pareto-optimal solutions based on the ability of firms and employees to exchange wage levels for payments periods. Employees and employers negotiate a "wage-package" that specifies the wage level and the payments interval. In the case of asymmetric access to bond markets mentioned in section 3B, lower real wages would be traded for more frequent payments.

Figure 3 illustrates the trade process between firms and workers under asymmetric access to the bonds market. The range between the flat part of firms and workers autarkic financial profit functions on the upper part of the figure 3, determines the height of the Edgeworth box in the lower part of the figure

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where lower real wages (which hurt workers but benefit firms) are traded for more frequent payments (which hurt firms but benefit workers). The rest of the analysis follows a standard textbook analysis, where the equilibrium rests at point O in the contract curve (ie., the locus of all Pareto-optimal "wage-packages"). This negotiation process is the driving force that makes the inflation elasticity of payments period in the case where only workers are constrained in the bonds market equal to the case where both agents are constrained.

Figure 3 illustrates potential effects of a rise in inflation rates in the previous "wage-package" outcome. The rise in inflation affects only employees payments period autarkic solution because it is not insulated against it by bond holdings. Since, firms bond holdings compensate for the inflationary rise, its payments period autarkic solution remains where it was. As a result, the contract curve is shifted outward because firms require a wage reduction to be further away from its unaltered autarkic payments period solution¹¹. The Pareto optimal "wage-package" in figure moves from point O to point O'.

Figure 3 can also illustrate the influences of wage regulation, say a binding minimum wage, on the inflation elasticity of payments periods. If in the initial equilibrium O the wage regulation is just binding, the movement from O to O' is impaired. In other words, the payments frequency-wage exchanges between firms and workers are not realized. This means that the wedge created between the payments period outcome and the Pareto-optimal solution increases with inflation. In sum, the inefficiency losses created by a binding wage regulation,

¹¹ The upper limit of the Edgeworth box will be increased with the inflation rise.

measured by the distance between the old indifference curve (w) and the new indifference curve (w'), increases with inflation¹².

B. NOMINAL WAGE RIGIDITY

A particular case of wage rigidity that may be more relevant for the recent Brazilian experience is the imposition of a nominal wage rigidity. In particular, the recent Brazilian legislation has imposed a nominal wage floor independently of payments dates. Since nominal wages are constant, the earlier are payments dates the higher is the real wage floor imposed by the Wage Law. Expression (12) establishes the relationship between nominal wage floors, payments frequency, inflation and real wage floors for the case of uniformly distributed real payments:

$$\underline{w}_n = \left(1 + \frac{1}{p}\right) \frac{T}{2} \pi \underline{w}_r \quad (12)$$

where:

\underline{w}_r = real wage floor

\underline{w}_n = nominal wage floor

The introduction of a nominal wage floor, specified by equation (12), as an extra constraint on workers, firms and their joint problems produces an increase (decrease) in firms (workers) marginal benefit from increasing the payment period. The combination of high inflation and long payment periods enables firms that face binding legal nominal wage floors to lower their effective labor cost. On the other hand, since the nominal rigidity mechanism represents a transfer between firms

¹² Of course, if wage floors are not binding or if firm's desired payments period are shorter than its employee's then a Pareto-optimal solution will prevail at all times.

and workers, the Pareto-optimal solution remains unchanged.

The overall result is that the introduction of a nominal wage floor will increase the differential between firms and workers' optimal payments period. This will lead to greater distortions since firms and workers are unable to exchange more frequent payments for lower wage levels. As opposed to the real wage rigidity case, nominal rigidity inefficiency effects do not rely on any asymmetry between firms and workers' access to bond markets. A prescription to reduce this distortion is to fix a real wage floor rule that follows equation (12) above: independent of the timing of payments and inflation rate, the real wage floor is constant.

Since firms have an incentive to postpone payments in the presence of a binding nominal wage floor, the Brazilian Wage Law limits the maximum payment interval. One consequence of imposing nominal wage rigidity and ceilings on the payment interval, is that when the Wage Law is binding the desired payments periods would be above the maximum allowed by the law while the observed payments period would be fixed at a corner solution at the maximum value allowed.

5. INTEGER RESTRICTIONS ON THE PAYMENTS FREQUENCY

The final extension of the benchmark model is to introduce aggregation effects of corner solutions in the model. These corner solutions are derived from integer constraints and non-negativity constraints on the number of transactions. This issue was first analyzed in Barro (1976) in the context of the Baumol-Tobin model. Since Barro (1976) assumes a given payment period and integer restrictions on the number of trips to the banks, the number of bank trips does not change continuously with changes in their determinants. Small changes in exogenous variables (for example, income or interest rates) generate

either no changes or big changes in the number of trips to the bank, depending on the relative position of the unconstrained solution with respect to the constrained solution¹³.

However, if the payments period is not fixed, it can act as a buffer compensating for changes in the desired number of bank trips that are not realized due to integer constraints. That is, changes in common determinants of the number of bank trips and of the payments period that do not affect the former variable may affect the latter. When these integer restrictions are binding, then the payments period work as in this case of Baumol's model (ie., compare equations (8) and (9)). More formally, local changes in the payments period away from its unconstrained optimal values may bring the financial profit closer to its constrained optimal.

In principle, the payment period (T/p) is a continuous variable that can smooth out part of the corner solutions imposed on the number of bank trips. However, since the payment frequency is a whole number, the imposition of binding ceilings on the payments period (ie. T_{\max}) by the Brazilian Wage Law restricts payments period (T/p) changes in a jumpy fashion¹⁴. As a result, the payments period role in smoothing corner solutions on the number of bank trips is lost. The final effect of the Wage Law integer restriction on payments frequency is to reduce short run movements of payments periods.

¹³ The conjunction of big jumps and small jumps among heterogeneous units tend to smooth out the aggregate number of bank trips.

¹⁴ In practice, the maximum allowed T is one month so payments intervals are restricted to monthly($T/1$), bi-weekly($T/2$), ten days($T/3$), weekly($T/4$) and so forth.

6. ARE PAYMENTS PERIODS RIGID? SOME TIME SERIES EVIDENCE

A. THE DATA

My basic source of payments period data derives from the PME-Pesquisa Mensal do Emprego public files. PME has information on payments frequency of employees main income source. There are four possible answers in the questionnaire: Monthly payments, Biweekly payments, Weekly payments and Other Forms of payments¹⁵. I will only consider the information on the first three payments categories mentioned above.

While PME has direct information on employees payment's periods, no such information is available for employers and self-employed individuals. However, most employers and self-employed individuals function as firms selling their products and services directly in the market. So one would expect, as is normally assumed for firms, a null payments period.

The following identity gives the average payment's period variable of the i -th region:

$$APP_i = \sum_{k=1}^n \%PP_{ki} \cdot PP_k$$

Where:

APP_{ki} = Average Payments Period for the i -th region

$\%PP_{ki}$ = k -th Group Income Share for the i -th region

PP_k = k -th Group Payments Period

(13)

¹⁵ In the data tape there is an additional category for Missing answers. Although, Missing answers are not very relevant, Other forms of payments create some problems. It includes on average 3% of the sample income and virtually disappears from 1987 onwards.

B. AVERAGE PAYMENTS PERIOD DETERMINATION

Since at least the "case of the missing money" episode occurred in the US during the mid-seventies, the search for proxies of financial innovation procedures has been a constant worry among those attempting to analyze money demand stability. The difficulty in measuring financial innovation implied that most of the approaches found in econometric practice were rather indirect, using either time trends to capture exogenous technological change or some function of previous peak interest rates as a proxy for endogenous reductions in transactions costs.

The average payments period variable described in the previous sub-section can be regarded as a measure of financial innovation with the advantages of being directly observed and of having its determinants and its money demand effects well defined by economic theory. The analysis started studying the impacts of inflation on the average payments period variable. The empirical tests used monthly data for the six main Brazilian metropolitan regions during the period from July 1982 to March 1993 (see figures 4 and 5). The analysis started using as the basic explanatory variable the inflation rate. The OLS inflation coefficient estimates clustered around the -0.057 to -0.021 interval and presented reasonably low standard errors (all with t -ratios above four). These estimates were within the $[-0.5, 0]$ range between Barro and Benchmark model predictions but much closer to the later. However, the results were not satisfactory since Johansen co-integration procedures did not reveal a long-run equilibrium relationship between average payments period and the inflation rate. Nevertheless, this failure may indicate a rigidity of payments practices. Another possible explanation for the failure of finding the mentioned co-integrating relationship are doubts about the existence of a unit root in

the data generation process of the inflation rate.

The next step was to replace inflation rate by its previous inflation peak. The new variable has a unit root by definition and attempts to capture an irreversibility of payments practices with respect to inflation¹⁶. The idea is that high inflation introduces an incentive to incur in the fixed costs of adopting more frequent payments such as the bargaining process between firms and workers, the cost of setting more frequent pay bills, the cost of switching from employee to self-employed occupations and so on. The use of previous peak variable is meant to capture the fact that once inflation rates decline the new payments practices tend to remain in place. In other words, the hatched effect captures an irreversibility of payments practices.

Figures 4 and 5 present the average payments period variable and the previous inflation peak across the main Brazilian metropolitan regions. The high degree of correlation between these variables is clear at first sight. To avoid the spurious regression problem implicit in OLS regressions relating variables integrated of order one, the co-integration analysis is provided below. The main purpose of this exercise is to evaluate the long-run elasticity of payments periods with respect to expected inflation.

The first step is to determine the order of integration of each time series to be used in the estimation. It can be shown that the average payments period variable and the previous inflation peak are integrated of order one¹⁷. In other words, the

¹⁶ For a previous discussion of the literature that uses the previous-peak variable in money demand see: Simpson and Porter (1980), Judd and Scandling (1982) and Roley (1985).

¹⁷ The fact that the previous inflation peak variable has a unit root follows directly from its definition as a hatched

data is stationary in their first differences but not in their levels. This satisfies a necessary condition to apply Johansen cointegration procedures.

Tables B and C present the results of Johansen co-integration tests for a data generation process without any kind of trend, it includes a constant and seasonal dummies¹⁸. The estimates are in a log-log specification and cover the six main Brazilian metropolitan regions and their simple average during the 1982.7 to 1993.3 period. Table C applies the two tests designed by Johansen to determine the number of cointegrating relationships among the variables: the maximum eigenvalue test and the trace test. The bottom part shows the normalized cointegration vectors (β 's) and their respective error correction coefficients (α 's). Both co-integration tests shows that it is not possible to reject at the 5% level the existence of one co-integrating vector in any of the six metropolitan regions. The signs of the normalized co-integrating vector (β 's) are in accordance with the theory. The long-run elasticity of the average payments period with respect to the previous inflation peak ranges from -0.1 to -0.05 across the six metropolitan regions¹⁹. These results lie within the expected inflation elasticity range [-0.5 , 0] delimited by Barro's model predictions and the prediction of rigid payments periods. This result suggests that an intermediary case, but much closer to

variable.

¹⁸ The qualitative results discussed below are independent of the kind of assumption used in the data generation process.

¹⁹ These simple OLS regressions of average payments periods against the previous peak of inflation in levels with no lags, a constant and seasonal dummies explain from 56% to 79% of the average payments periods variance across the six metropolitan regions.

the complete insensitivity of payments practices with respect to inflation provide a reasonably robust description of payments period determination across the main Brazilian metropolitan regions.

C. SPLITTING THE AVERAGE PAYMENTS PERIOD

To get a better understanding of the determinants of average payments period, I split this variable in two components. The assumption that employers and self-employed individuals receive their income on a continuous basis (ie. a null payments period) imply that the payments period variable (recall equation (13)) collapses to:

$$APP_i = \%E_i \cdot EAPP_i$$

Where:

APP_i = Average Payments Period in the i -th region

$\%E_i$ = Employees income share in the i -th region

$EAPP_i$ = Employees Average Payments Period in the i -th region

(14)

According to equation (14) there are two sources of changes in the average payments period variable: a) Changes in the average payments period of employees. b) Changes in the labor market segments' composition, from employees to self-employed and employers or vice-versa. The separate analysis of the effects of changes in labor market segments composition should throw light on what is driving the observed average payments period variable reactions with respect to the previous inflation peak.

D. THE DETERMINATION OF EMPLOYEES SHARE IN INCOME

Figure 6 present employees average payments period across the six main Brazilian metropolitan regions. It can be shown that employees average payments period is also integrated of order one²⁰. Tables D and E replicates Johansen co-integration tests previously applied to the average payments period variable to the employees share in income. The co-integration tests results found are very similar to the ones found for the average payments period variable. According to the maximum eigenvalue test and the trace test, it is not possible to reject the existence of one co-integrating vector in all regions. The long-run elasticity of the average payments period with respect to the previous inflation peak ranges from -0.065 to -0.045 across the six metropolitan regions. This elasticity range is narrower than the one found for the average payments period.

Comparing these elasticities with the ones found for the average payments period region by region they are smaller (but not much smaller) for five of the six regions. The exception is Porto Alegre. These results suggest that most of the impact of the previous inflation peak on the average payments period variable should operate through the employees share in income. This leaves some (little) room for employees' average payments period variable²¹.

ibid footnote 18.

The simple OLS regressions of employees share in income against the previous peak of inflation in levels with no lags, a constant and seasonal dummies produced similar elasticities estimates and explain from 53% to 79% of the endogenous variable variance across the six metropolitan regions.

E. THE DETERMINATION OF EMPLOYEES' AVERAGE PAYMENTS PERIOD

Figure 7 presents employees average payments period across the six PME regions. It can also be shown that employees average payments period is integrated of order one in all regions²². Tables F and G replicates Johansen co-integration tests previously applied to the overall average payments period to employees average payments period.

The results are much less homogeneous across metropolitan regions than the ones found in the two previous sub-sections. Three of the six regions (Belo Horizonte, Rio de Janeiro and Sao Paulo) present one co-integrating vector according to the maximum eigenvalue test and the trace test at the 5% level. Porto Alegre presents one co-integrating vector according to the maximum eigenvalue test but the trace test rejects this hypothesis. In the two remaining metropolitan regions (Recife and Salvador) the hypothesis of existence of co-integrating relationships between the average payments period variable and the previous inflation peak is rejected at the 5% level.

The coefficients of the normalized co-integrating vector (β 's) found for Belo Horizonte, Rio de Janeiro and Sao Paulo are still in accordance with the theory. The long-run elasticity of the average payments period with respect to the previous inflation peak is smaller in these regions than the ones found for average payments periods and employees share of income co-integrating system with the inflation peak variable²³. These results also lie within the elasticity range $[-0.5, 0]$ delimited by Barro and a fixed payments periods. They suggest

ibid footnote 18.

The simple OLS regressions of average payments periods against the previous peak of inflation in levels with no lags, a constant and seasonal dummies explain from 7% to 37% of the average payments periods variance across these three metropolitan regions.

that an intermediary case but much closer can not be rejected as a description of employees payments period determination across the main Brazilian metropolitan regions. In sum, the employees average payments period evidence for Belo Horizonte, Rio de Janeiro and Sao Paulo are even more favorable to the prediction of rigid payments periods than the overall average payments period evidence.

7. SOURCES OF PAYMENTS PRACTICES RIGIDITY: AN EMPIRICAL ASSESSMENT

The purpose of this section is to evaluate the relative importance of the different sources of payments practices analyzed in the paper. The benchmark case represented by equation 7 produces a complete insensitivity of payments periods to inflation. The idea is that firms and employees can reduce cash holdings through bonds holdings in a more efficient way than through payments periods reductions. Whether this is the case or not, it is an empirical matter. Figure 8 shows the distribution of liquid assets ownership across different metropolitan regions. Except for Sao Paulo and for the case of US dollars in Belo Horizonte, none of the eight metropolitan regions presented more than 2 percent of the adult population using any of these short run assets. This evidence suggests that the assumptions posed by the benchmark case are somewhat unsatisfactory.

Another prediction of the benchmark case is an inverse relationship between income levels and payments periods. One possibility to neutralize this effect is to assume that transaction costs are of an income forgone nature. In this case the earnings-transactions cost ratio of equation (7) is independent of earnings. However, these predictions are not supported by the empirical evidence. Figure 9 presents the ratio between each payments period group average income and the

average income of all payments periods groups. We see that the high frequency group (self-employed and employers) presents the highest average income and that weekly paid workers are the lowest paid workers of all. The later group earns on average nearly one half of the former group income. Within the employees group there is a positive relationship between payments periods and earnings in all metropolitan regions.

Figure 10 presents the short run portfolio by family income brackets for the same metropolitan regions. It shows that low income individuals do not possess inflation proof liquid assets. The ownership of all liquid assets is progressive, the share of adults with family income below five minimum wages that possess these assets is close to zero. This might be incorporated in the benchmark case as a positive relationship between earnings and the rate of return of alternative assets (for example, setting $(dr_b/dY) > 0$ in equation (7)). This evidence can potentially explain the positive relationship between payments periods and earnings among employees mentioned.

Since individual firms manage bigger cash-flows than individual workers they are expected to use bond markets more intensively. Therefore, the movement from the benchmark case to the case where there exists an asymmetric access to bond holdings between firms and employees seems to go in the direction of realism. However, it is per se insufficient to explain the low inflation elasticity of payments periods presented in the time series exercises. If firms and employees can freely tradeoff changes in wages for changes in payments frequency then firms can provide their employees the benefits of bond holdings through more frequent payments at the expense of lower wages. This negotiation process is the driving force that makes the inflation elasticity of payments period in the case that only workers are constrained in the bonds market equal

to the case where both agents are constrained.

All cases reviewed so far in this section are Pareto-optimal in the sense of resulting from the maximization of firms and employees total financial profits. This joint cost minimization procedure may be impaired by wage floors imposed by the Brazilian Wage Law. A way to assess the distortion induced by the Wage Law is to compare the payments habits of individuals covered by the Wage Law (ie., legal employees - trabalhadores com carteira) with those in the non covered sector (ie., illegal employees trabalhadores sem carteira). Table A1 below shows that during the 1982-1993 interval the average payments period of legal employees were longer than illegal employees payments periods in all six metropolitan regions. The average difference of average payments periods across these regions was approximately two days (ie., 27.8 for legal employees and 25.7 for illegal employees).

TABLE A1 - EMPLOYEES AVERAGE PAYMENTS PERIOD - 1982.6-93.7

	BELO HORIZ	PORTO ALEGRE	RECIFE	RIO DE JANEIRO	SALVADOR	SAO PAULO
ILLEGAL	26.39	26.70	21.40	26.56	25.20	27.95
LEGAL	28.17	26.98	25.43	28.55	28.37	29.11

A particular source of wage rigidity present in the Brazilian case is the imposition of nominal wage floors that are invariant of the payments date chosen. In the cases where these wage floors are binding, the combination between high inflation and long payments periods provide firms the desired labor cost saving device. Given firms incentives to postpone payments, the Brazilian Wage Law limits the maximum interval between income is earned and paid. Firms have to pay wages and salaries earned in a given month until the first working day after the fourth of the next month. A first consequence of imposing nominal wage rigidity and ceilings on the payment's interval, is that when

the Wage Law is binding payments dates should be at the legal limit. In this context, a bidding restriction on payments dates also implies in an upper bound on the payments period equivalent to one month. In this sense payments dates and payments periods are both measures of the pressure exerted by the Wage Law on earnings.

The comparison between the share of legal and illegal employees with monthly payments provides a more accurate assessment of the impact of wage rigidity on payments practises than the comparison of these groups average payments periods presented in Table A1. Table A2 below shows that in five of the six PME metropolitan regions, the share of monthly paid legal employees surpasses the share of monthly paid illegal employees. The simple average across these metropolitan regions for legal and illegal employees are 83% and 79%, respectively. The wage rigidity argument seems to work here but it does not seem empirically very relevant.

TABLE A2 -AVERAGE SHARE (%) OF MONTHLY PAYMENTS AMONG EMPLOYEES - 1982.6-93.7

	BELO HORIZ	PORTO ALEGRE	RECIFE	RIO DE JANEIRO	SALVADOR	SAO PAULO
ILLEGAL	82.63	80.68	63.73	82.78	80.15	83.56
LEGAL	85.72	81.48	69.47	88.97	89.90	83.28

The next measure of the pressure of the Wage Law on payments practices analyzed is the distribution of payments dates. Figure 11 presents the distribution of payments dates among legal and illegal employees that are paid on a monthly basis²⁴. This data derives from a special supplement of PME

²⁴ This payments question was also made for the remaining payments period groups. However, when an individual receives it does not make sense to ask a unique payments date. The bad specification of the questionnaire was reflected in the high non response rate for other payments periods groups (always above 65%) while monthly paid individuals non response rate were lower than 10%.

questionnaire about payments dates during the month of June 1994²⁵. Figure 11 shows a concentration of payments dates outcomes between the 25th and the 10th of the following month. There is also a preference for payments dates that are multiples of five, specially among legal employees. The high concentration of payments dates on the 30th is the main feature of legal and illegal employees data. We observe a relative concentration of payments dates on the 5th and the 6th (ie., the legal limit because the fifth fell on a Sunday). The relative concentration of payments dates between the new and the old legal limit (ie., the 6th and the 10th, respectively) may indicate the presence of habit lags in payments practices.

As we found for payments periods, legal employees tend to have payments dates closer to the legal limit than illegal employees ones. The proportion of legal employees pay day at the legal limit was nearly twice the proportion found for illegal employees. One explanation for this relative small difference in payments practices is that legal employees may act as a role model for illegal employees. The overall conclusion is that most payments dates are close to the maximum allowed limit but not exactly there. The concentration of payments dates on the 30th but not the 6th may be explained by the relatively small gain obtained even during high inflation and perhaps by some inconvenience of starting a new working month withstanding debt of firms with workers.

Finally, the aggregate time-series analysis of section 5 provides very scarce information on the actual mobility between payments practices. The analysis of transition probabilities between different payments periods groups provide a more

²⁵ The proximity with the Real plan launched in July 1994 may distort the distribution of payments date used here.

adequate evidence on payments period rigidity. The transition probabilities presented in figures 8 and 9 are estimated from a concatenated sample individuals taken from PME files for Sao Paulo²⁶. We use the following convention: C - continuous payments, M - Monthly, B - Biweekly, W - Weekly and O - Other forms. The first letter refers to the payments period observed in the first month and the second letter the payments period observed in the second month. For example, CM stands for the average monthly transition probability from continuous payments to monthly payments during a certain time period. Figure 9 imposes the condition that during two consecutive months earnings were positive. Figure 10 imposes the additional condition that individuals did not change jobs during two consecutive months. Both figures present average transition probabilities for the following sub-periods 82.3-93.12, 82.3-87.5 and 87.5-93.12.

The main feature of both figures is the high probability (always above 88%) that monthly and continuously paid individuals keep the same payments mode between two consecutive observations. The corresponding probabilities for the remaining payments periods groups (biweekly, weekly and other forms of payments) is much smaller in relative terms (never above 65%). The fact that monthly and continuous payments are more absorbing states is consistent with them being corner solutions. Any mass change in the tails of the distribution of desired payments practices that does not cross the upper and lower bounds of effective payments (ie., monthly and continuously payments) will not be observed in practice.

²⁶ See, Neri (1995) for a general description of the longitudinal information used here.

7. CONCLUSIONS

This paper studied the joint determination of the payments period between firms and employees. The framework developed here extends Barro's (1970) model in the following aspects: a) the model incorporates interactions between optimal payments period decisions and optimal number of trips to the bank. b) the model studies the occurrence of Pareto inefficiencies in the bargaining process between firms and employees due to wage regulation. c) the model also incorporates integer restrictions on payments frequencies due to the imposition of upper bounds on the payments period.

The empirical analysis started applying Johansen co-integration procedures to aggregate Brazilian time-series and reached two conclusions: a) the average payments period variable keeps an equilibrium relationship with the previous inflation peak what indicates some degree of irreversibility of payments practices. b) the low estimates of the previous inflation peak elasticity of payments period found reveals a high degree of rigidity of payments practices.

The main part of the empirical analysis assessed possible sources of payments practices rigidity found in the recent Brazilian experience using micro data:

a) The benchmark model constructed in this paper provides a basic rationale for payments periods rigidity: the existence of short-run assets that provide a less costly mechanism to economize on cash balances than changes in payments periods. However, as the data shows the high proportion of household without short-run assets and the inverse relation between employees payments groups earnings and their respective payments period poses objections to a basic assumption and to a basic result of the benchmark model.

b) The real wage rigidity explanation looks at the

difficulties of firms and employees in agreeing on a joint payments period decision. This story is intuitive when there is an asymmetry between firms and employees access to bond markets and in the case of a very regulated labor market like the Brazilian one. The differences in payments practices between employees subject to direct wage regulation and those that are not provide some empirical support to the wage rigidity mechanism. Legal employees have a higher share of monthly payments and those that are paid on a monthly basis get paid at dates closer to the legal limit. However, the observed differences between legal and illegal employees payments practices are not very relevant.

c) Finally, nominal wage rigidity with upper bounds on payments dates stands as a simple and powerful source of payments practices rigidity. It provides the motivation for firms to push payments frequencies and payments dates toward a corner solution. This fact is confirmed by the relatively small probability that monthly paid workers change to a different payments mode. Nevertheless, most payments dates are not exactly situated at the legal limit.

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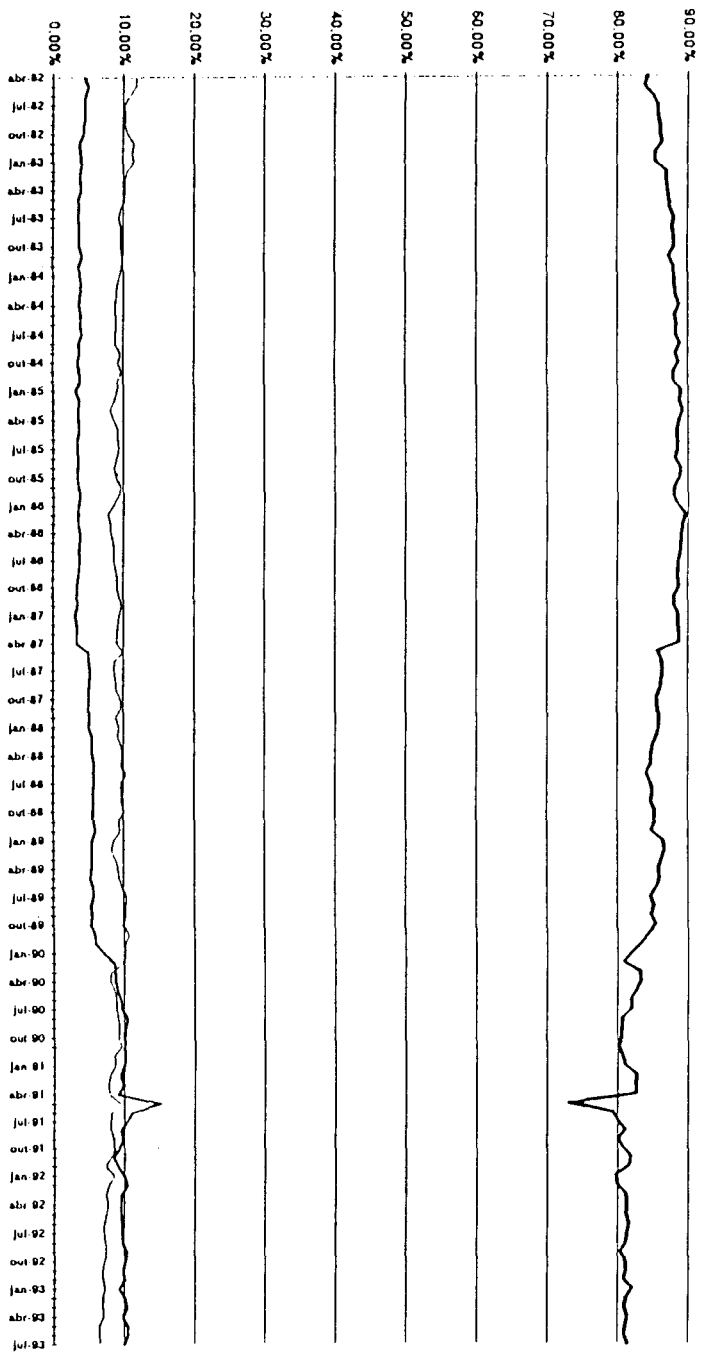
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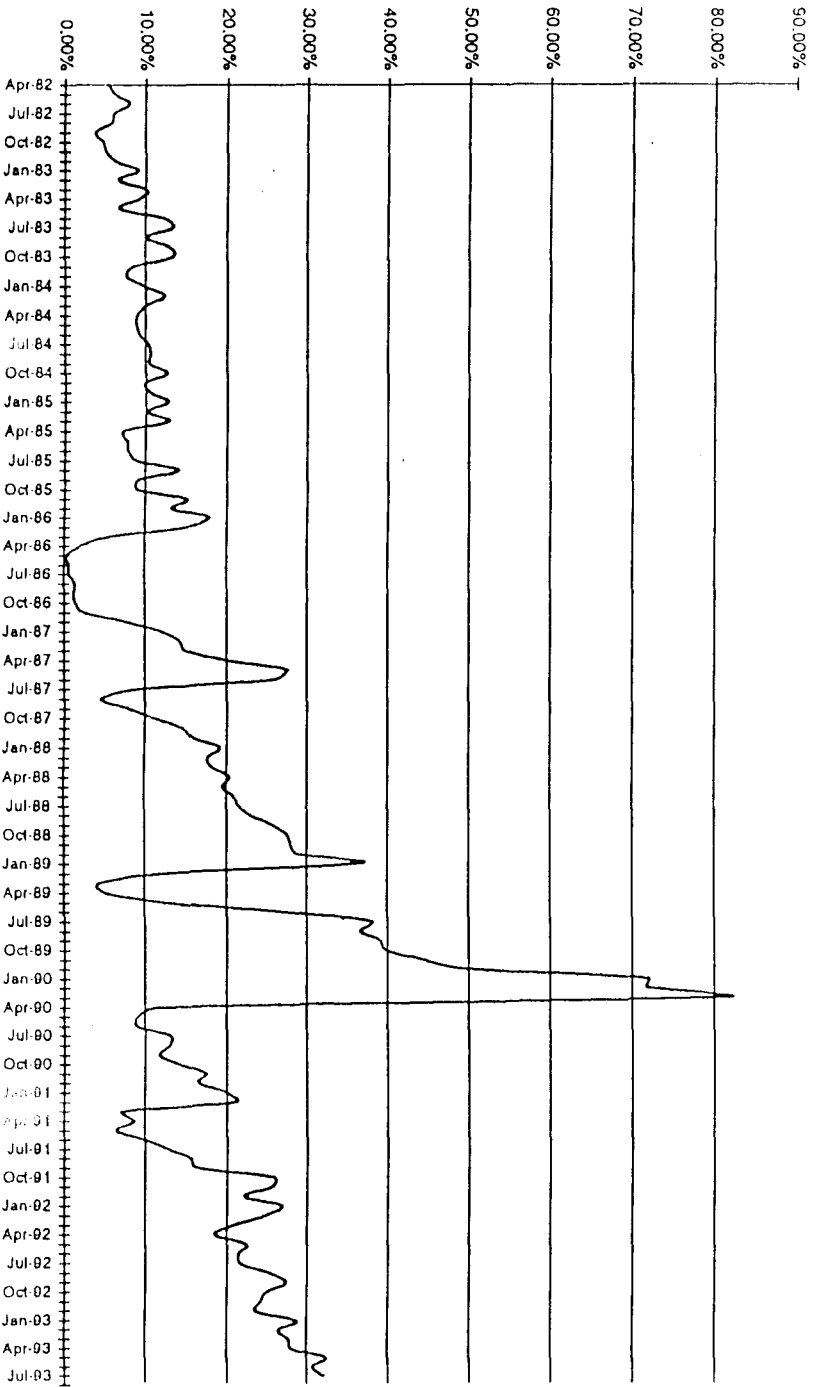
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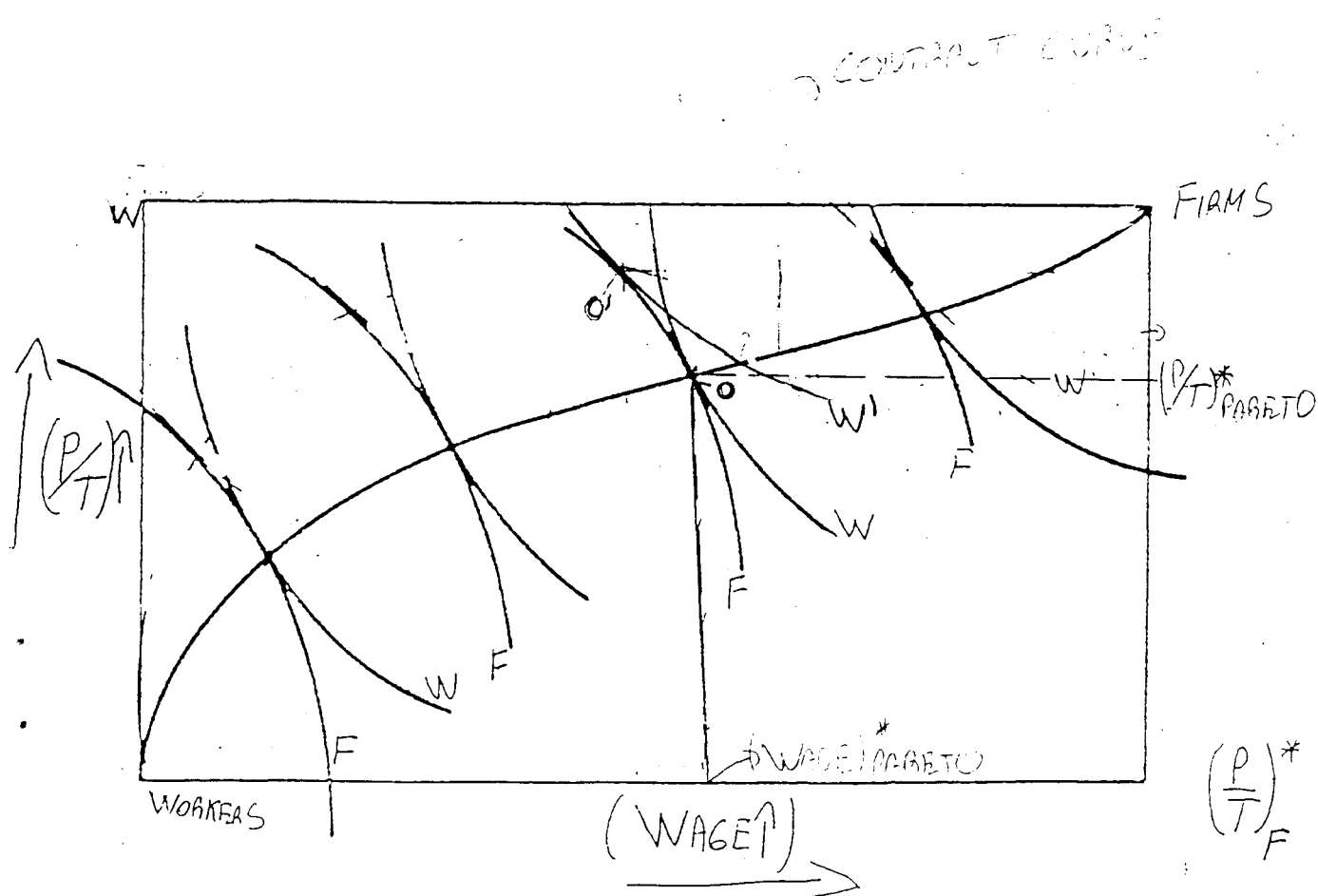
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1 Payments Frequencies Among Employees - Simple Average

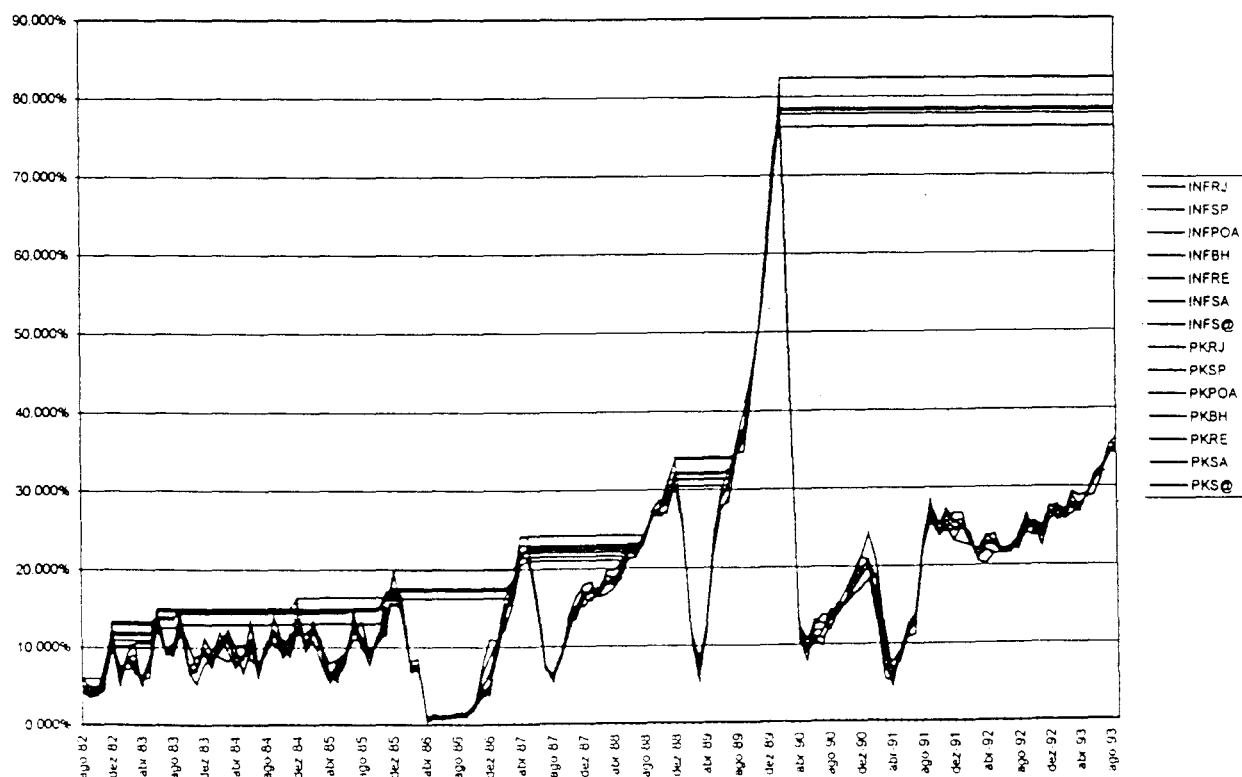
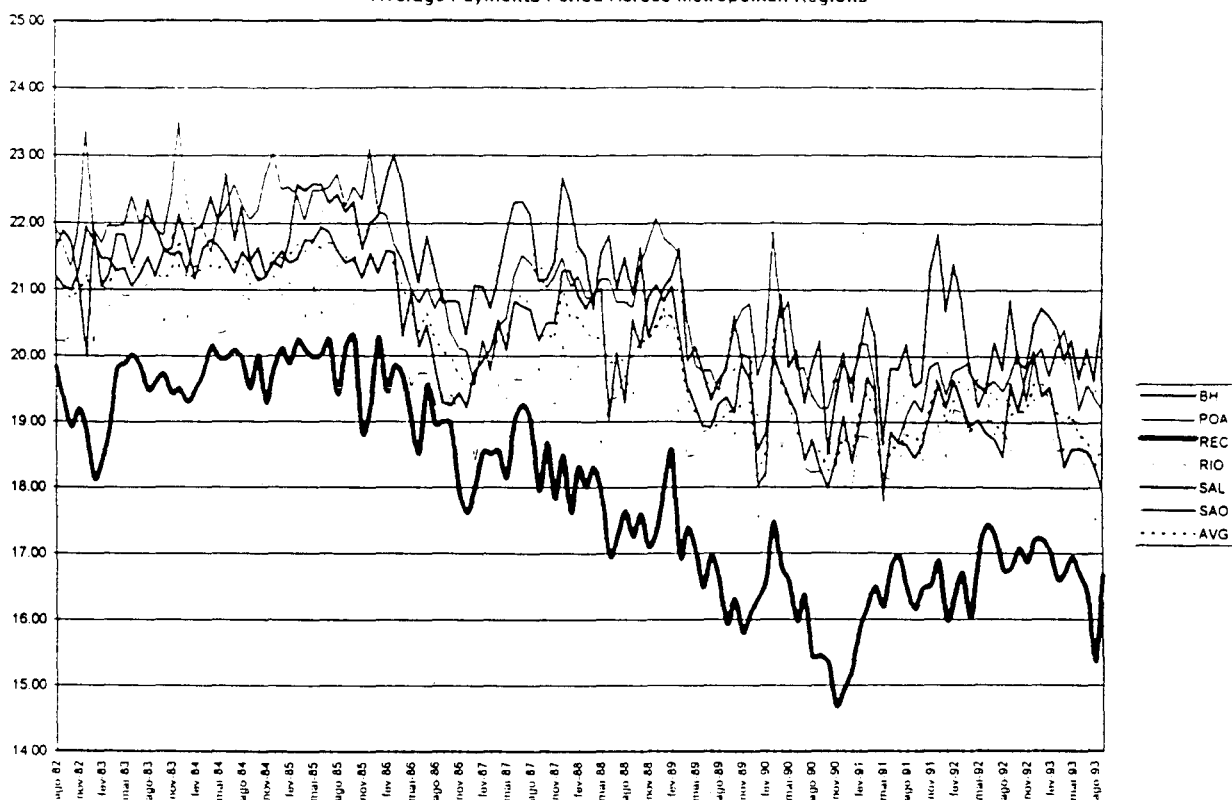


2 MONTHLY INFLATION RATES (GPI-FGV)

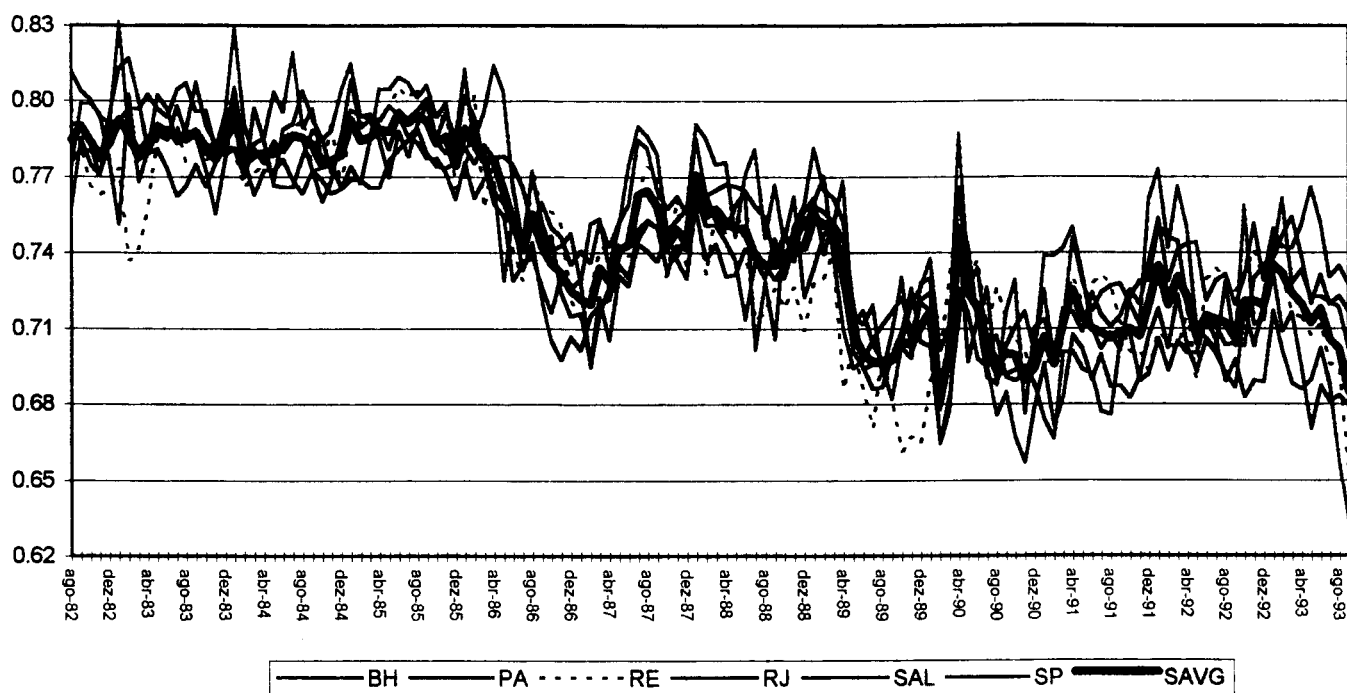




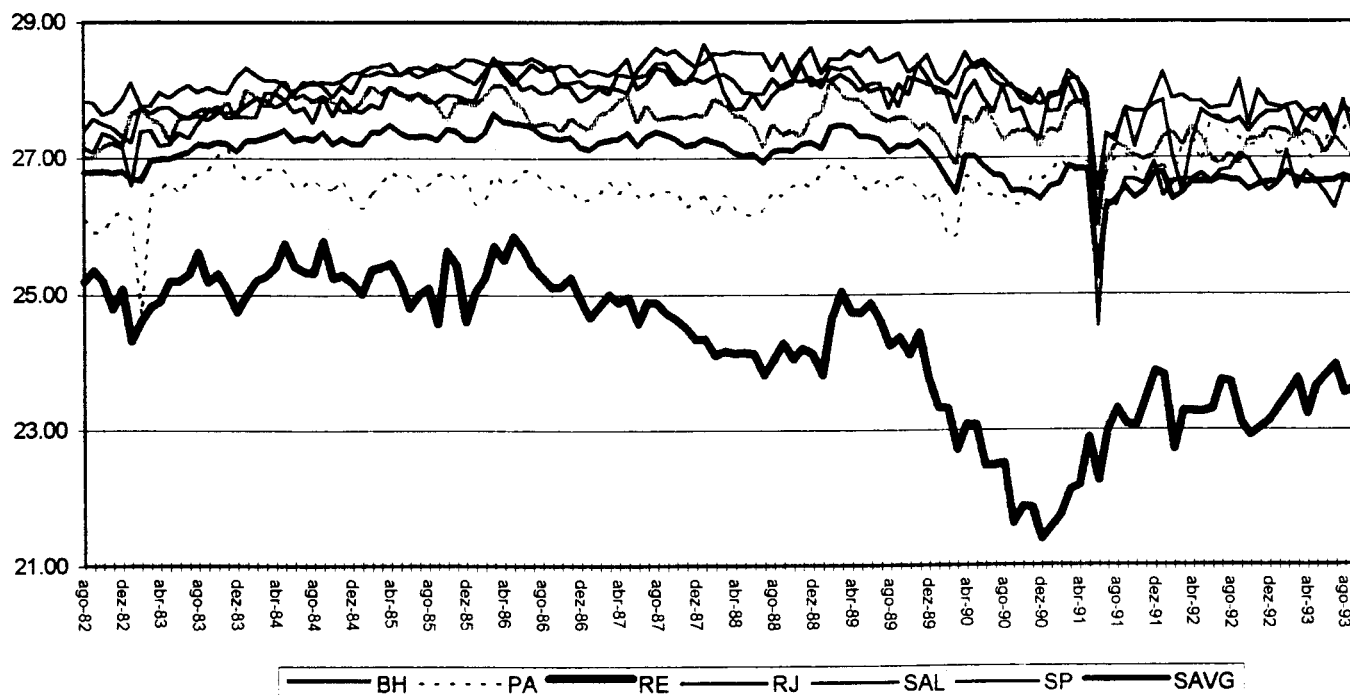
Pareto Efficiency in the Edgeworth Box



6. EMPLOYEES' SHARE IN INCOME

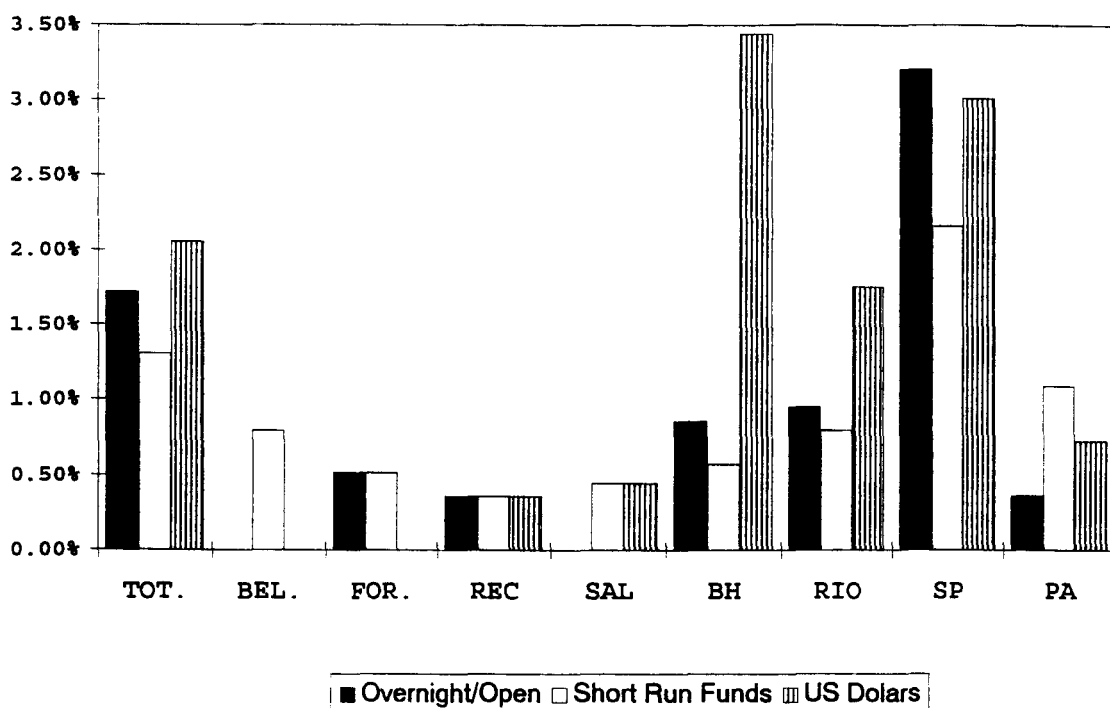


7. EMPLOYEES' AVERAGE PAYMENTS PERIOD (in days)

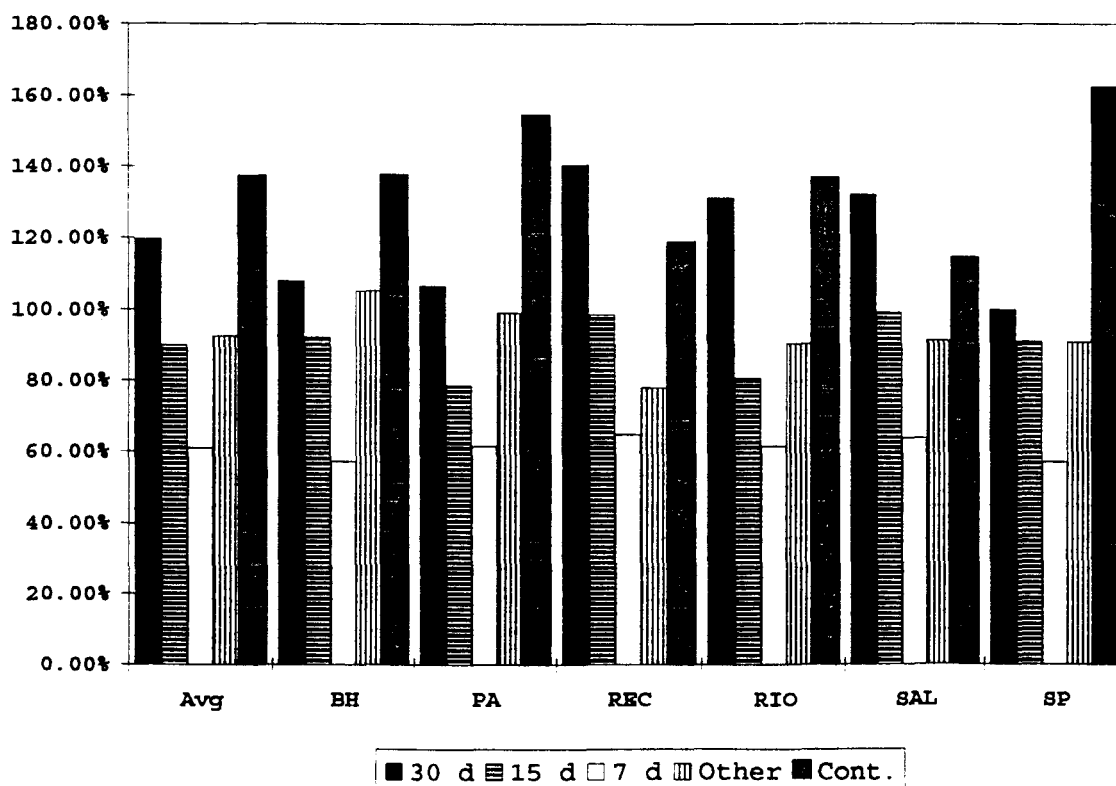


Source: PME

8. POSSESSION OF SHORT RUN FINANCIAL ASSETS (a)

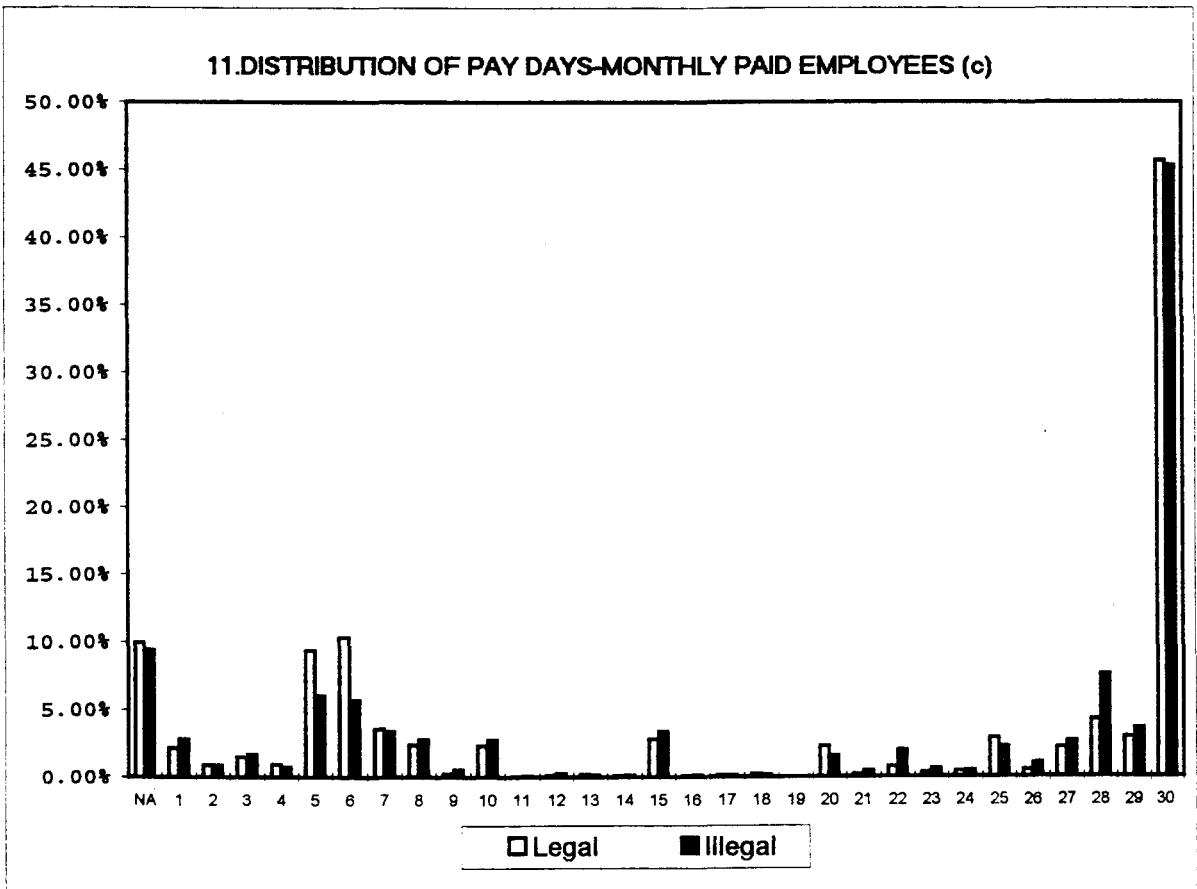
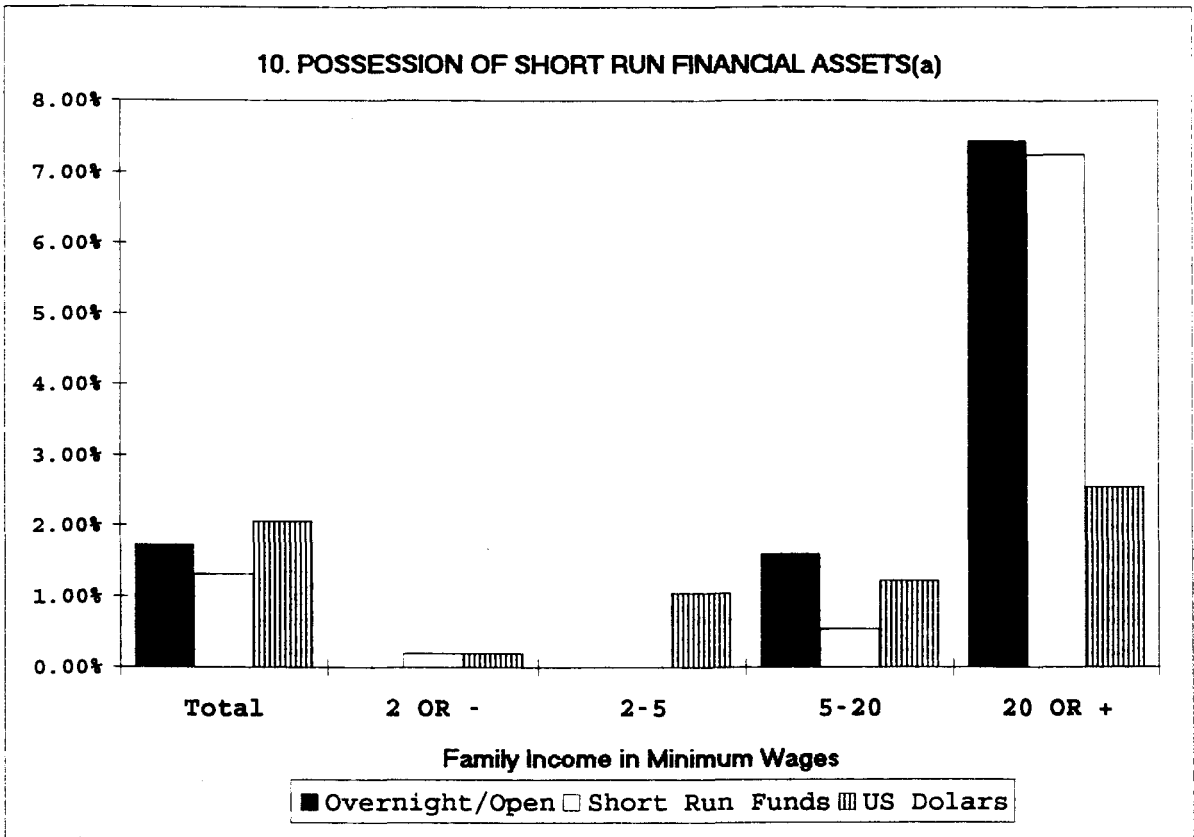


9. AVERAGE INCOME RATIOS OF PAYMENTS PERIODS GROUPS (b)



(a) ABECIP March 1987 - 8 Main Metropolitan regions

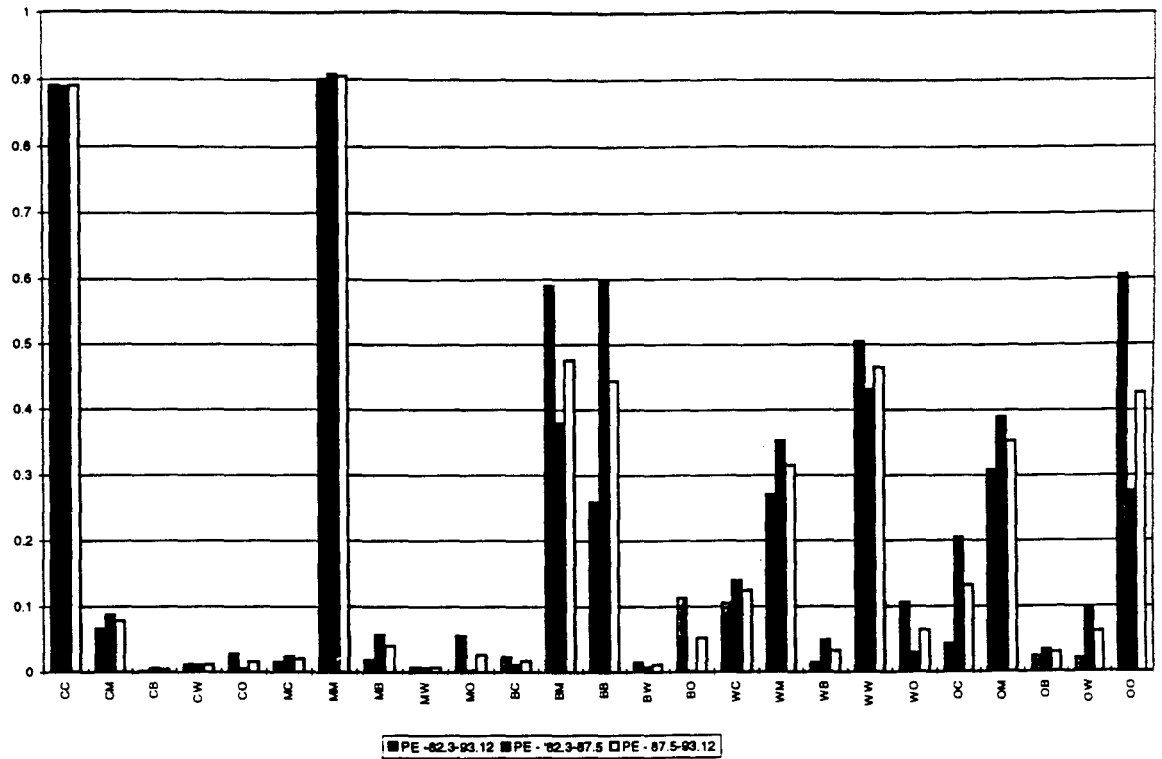
(b) PME March 1987 - 6 Main Metropolitan regions



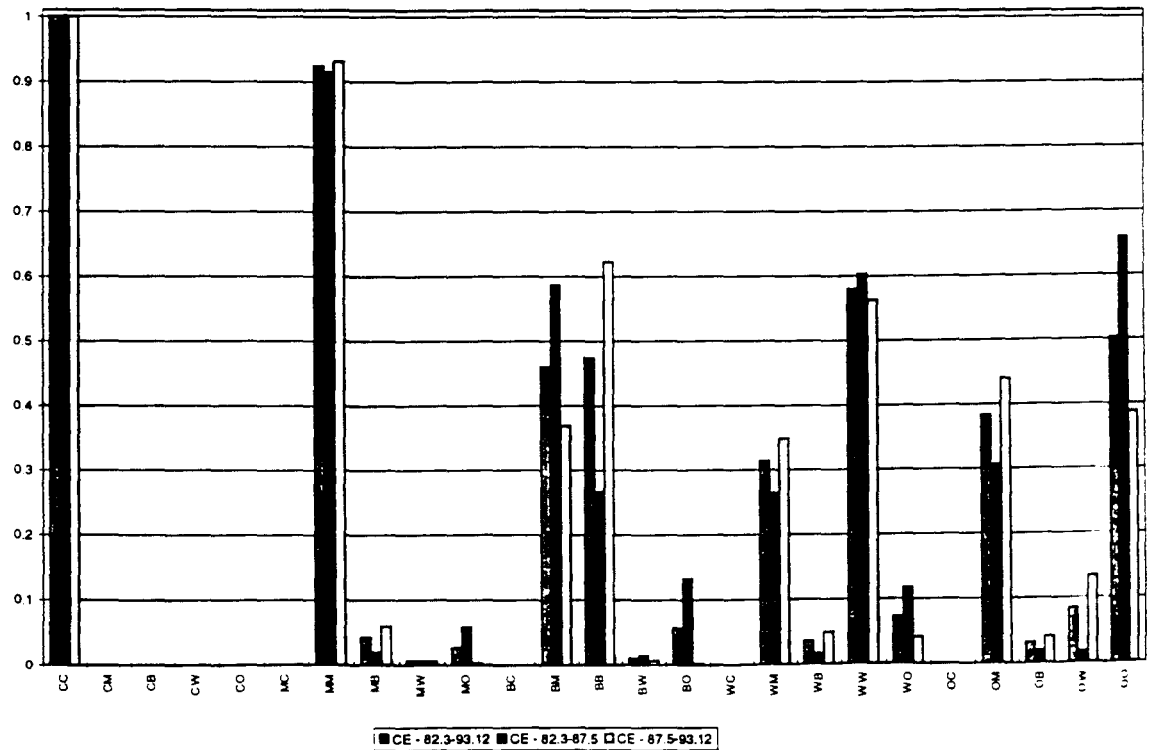
(a) ABECIP March 1987 - 8 Main Metropolitan regions

(c) PME June 1994 - Average 6 Main Metropolitan regions

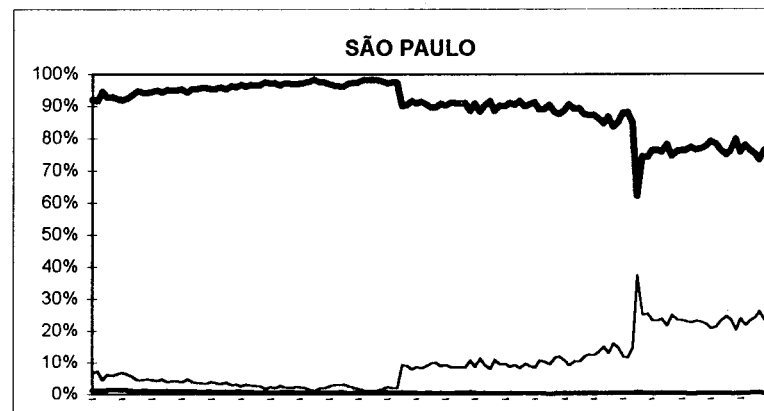
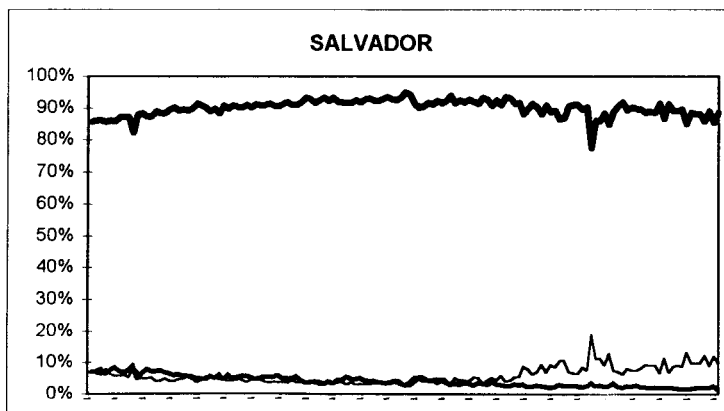
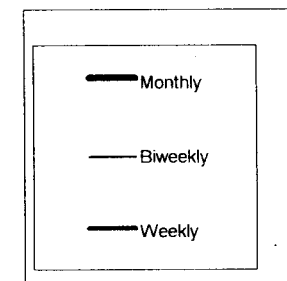
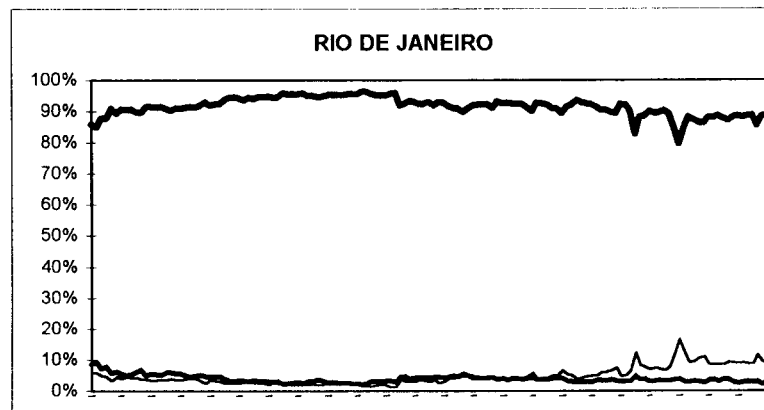
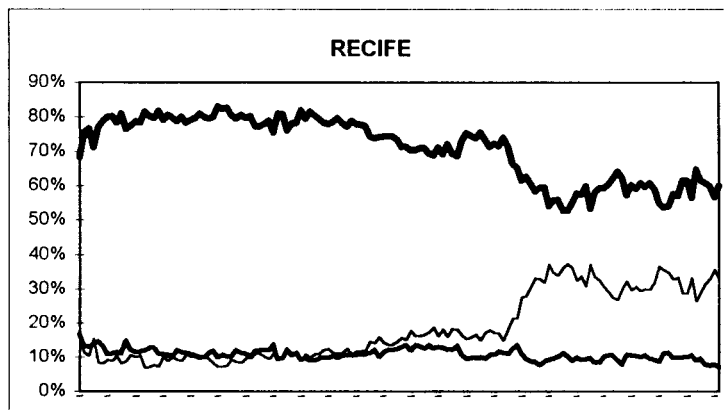
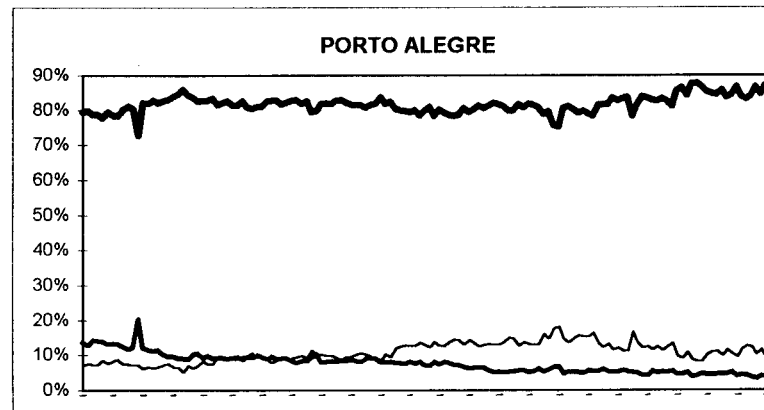
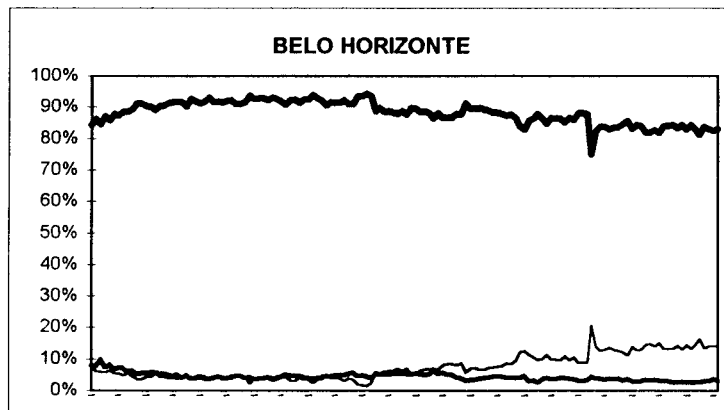
TRANSITION PROBABILITIES SUB-PERIODS - POSITIVE EARNINGS



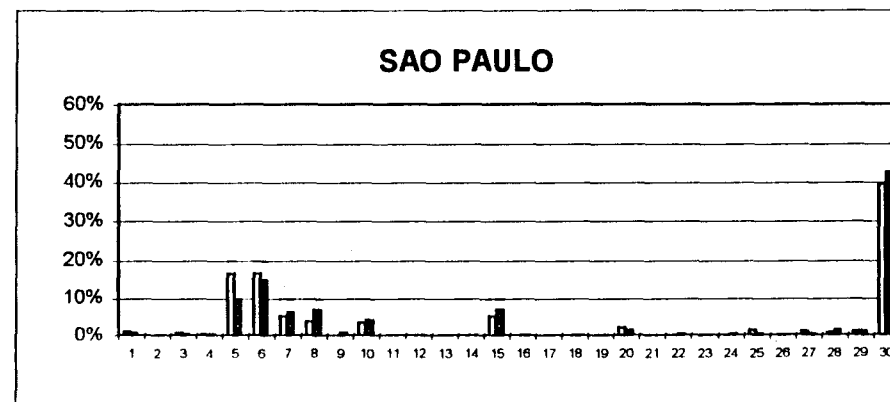
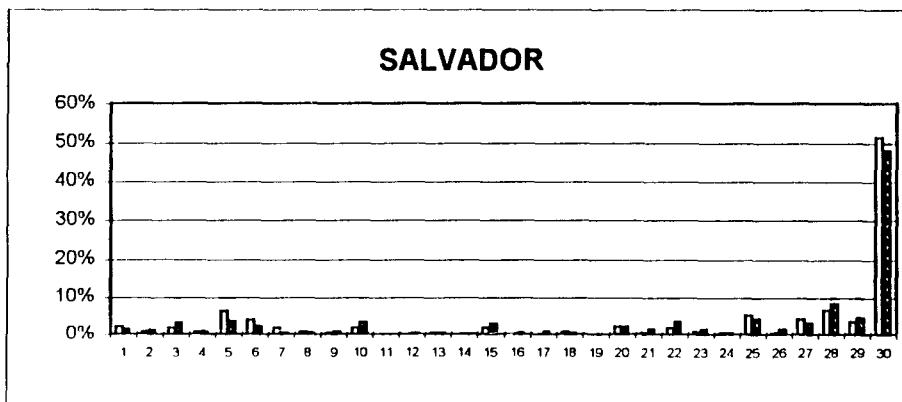
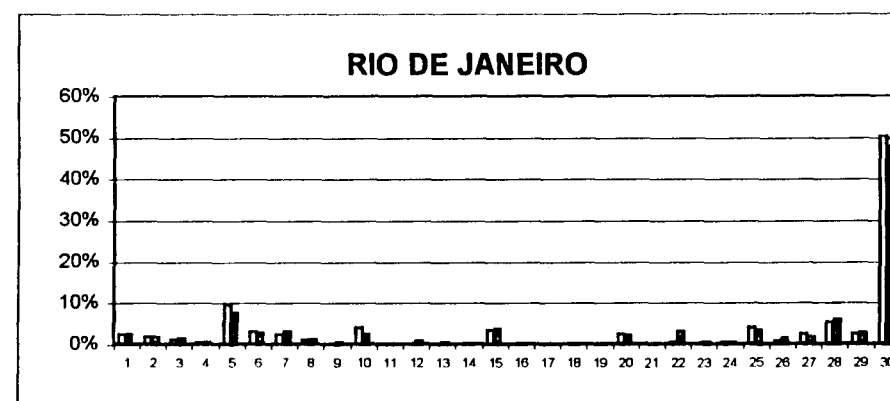
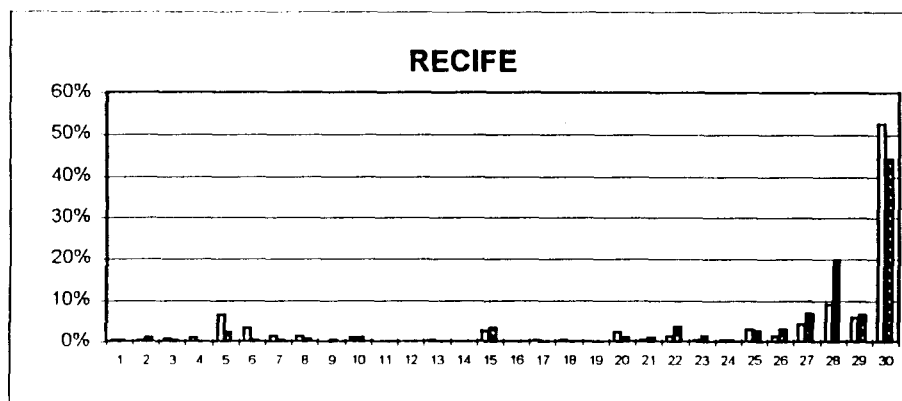
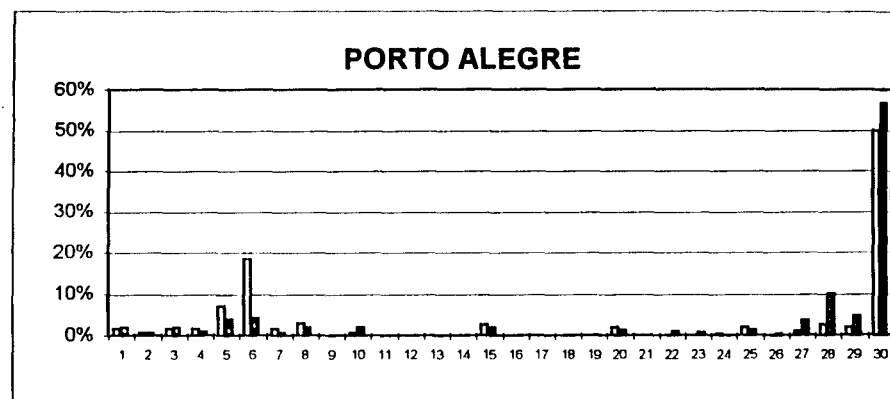
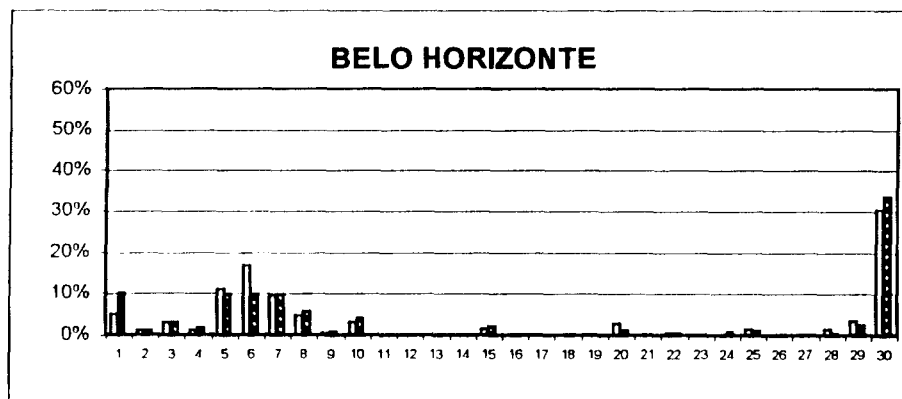
TRANSITION PROBABILITIES SUB-PERIODS - "CONTINUOUSLY EMPLOYED INDIVIDUALS"



PAYMENTS PERIODS DISTRIBUTION AMONG EMPLOYEES (1982.3-1993.10)



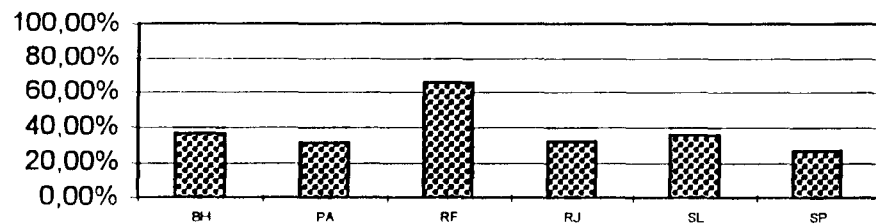
FORMAL AND INFORMAL EMPLOYEES WITH MONTHLY PAYMENTS PAY DAY DISTRIBUTION BY METROPOLITAN REGION



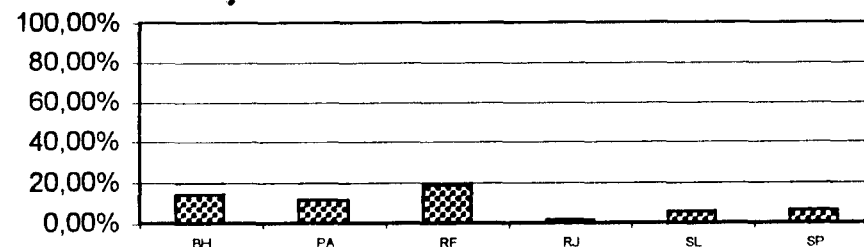
SOURCE: PME JUNE 1994

NO ANSWERS OF PAY DAY BY PAYMENTS DATE AND METROPOLITAN REGION

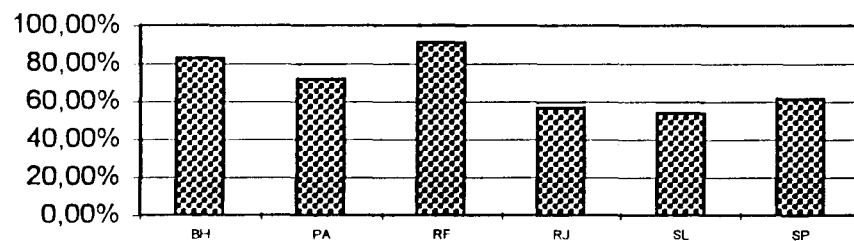
TOTAL



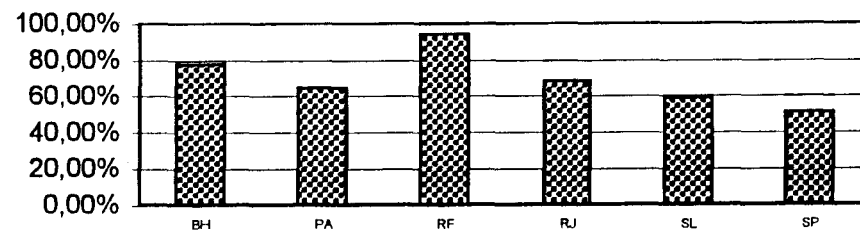
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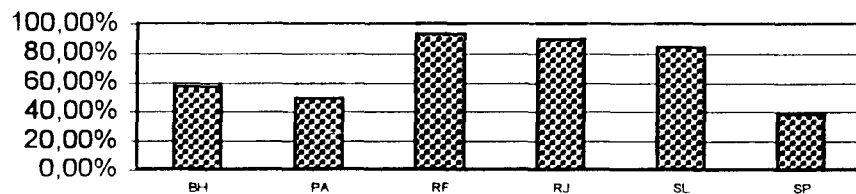
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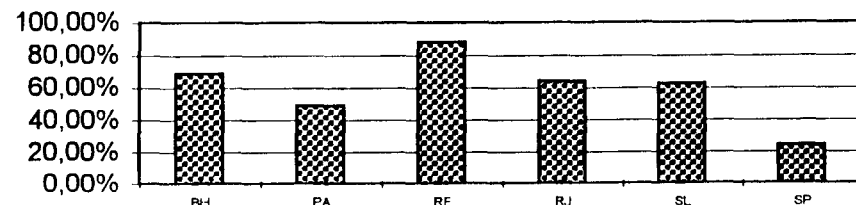
WEEKLY



CONTINUOUS

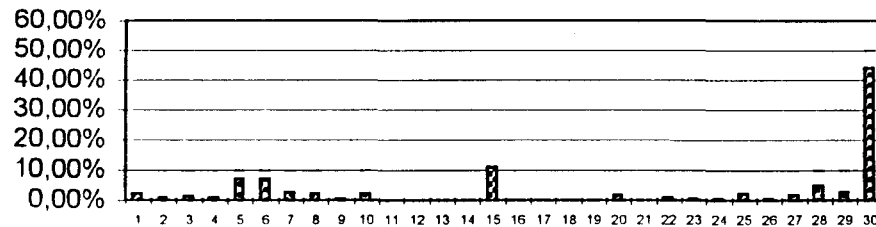


OTHER

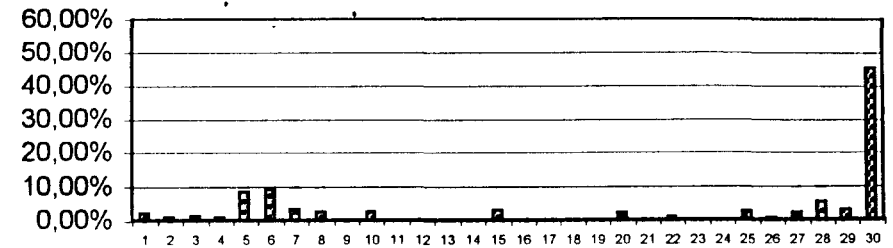


ALL METROPOLITAN REGIONS PAY DAY BY PAYMENTS PERIOD

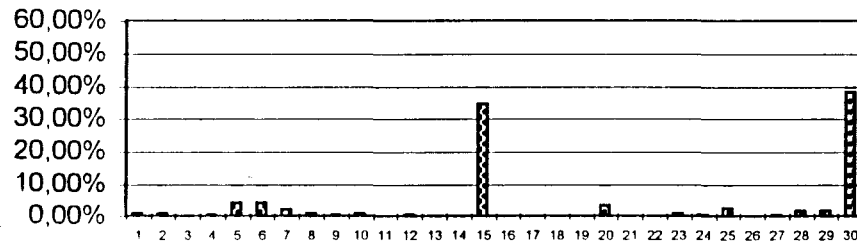
TOTAL



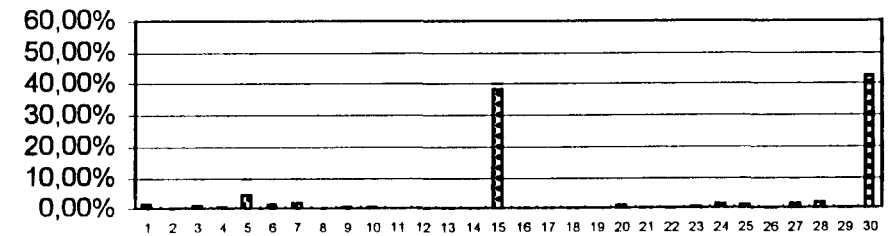
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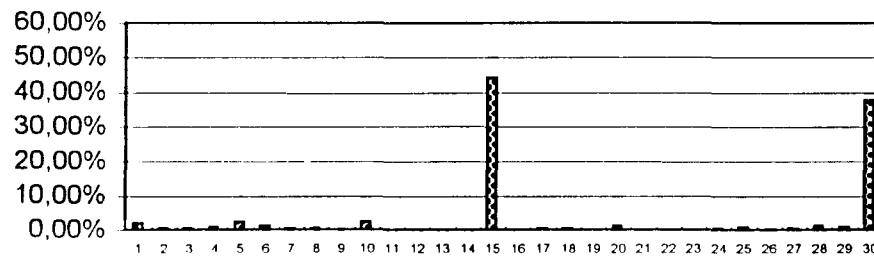
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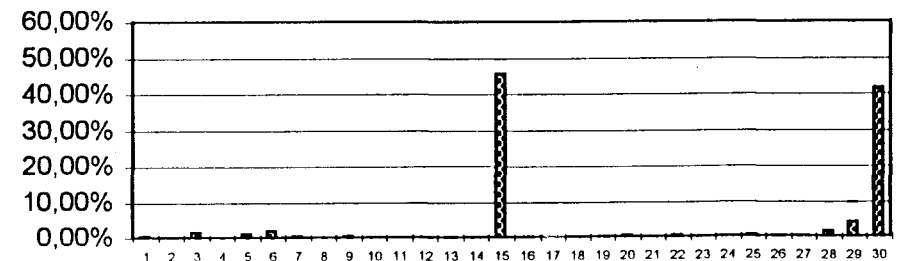
WEEKLY



CONTINUOUS



OTHER





N.Cham. P/EPGE SPE N445s

Autor: Neri, Marcelo Cortes.

Título: Sources of payments practices rigidity.



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