NBER WORKING PAPER SERIES

EXCHANGE RATES AND JOBS: WHAT DO WE LEARN FROM JOB FLOWS?

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Working Paper 6864
http://www.nber.org/papers/w6864

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
December 1998

Prepared for the 1998 NBER Macro Annual Conference, Cambridge, MA. I thank Ben Bernanke, Olivier Blanchard, Ricardo Caballero, Bob Hall, Mike Horvath, Jonathan Parker, Paul Romer, Julio Rotemberg, Tom Sargent, and the participants at the Stanford graduate school of business weekly lunch and Economics department macro lunch for their comments. The views expressed here are those of the author and do not reflect those of the National Bureau of Economic Research.

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JEL No. E32, F16, F31, J41

ABSTRACT

Currency fluctuations provide a substantial source of movements in relative prices that is largely exogenous to the firm. This paper evaluates empirically and theoretically the importance of exchange rate movements on job reallocation across and within sectors. The objective is (1) to provide accurate estimates of the impact of exchange rate fluctuations and (2) to further our understanding of how reallocative shocks propagate through the economy. The empirical results indicate that exchange rates have a significant effect of gross and net job flows in the traded goods sector. Moreover, the paper finds that job creation and destruction comove positively, following a real exchange rate shock. Appreciations are associated with additional turbulence, and depreciations with a "chill." The paper than argues that existing non-representative agent reallocation models have a hard time replicating the salient features of the data. The results indicate a strong tension between the positive comovements of gross flows in response to reallocative disturbances and the negative comovement in response to aggregate shocks.

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1. INTRODUCTION

This paper investigates the effect of real exchange rate movements on net and gross job reallocation in the US manufacturing sector. Interpreting real exchange rate shocks as reallocation shocks, it then draws implications for modern business cycle theories. Real exchange rates measure the relative price of domestic and foreign baskets of goods. Their fluctuations are pronounced and very persistent. Figure 1 reports the US effective real and nominal exchange rates from 1972 to 1996. Most striking over this period, is the 40% appreciation of the dollar from 1980 to 1985, followed by a no-less spectacular depreciation that lasted until the early 1990s. Using disaggregated quarterly data for the US manufacturing from 1972 to 1988, I argue that such movements in relative prices induce a sizeable job reallocation, both across and within narrowly defined tradable industries. To preview the paper's main results, the benchmark estimation yields an average 0.27% contraction in tradable employment over the 3 quarters following a mild 10% appreciation of the real exchange rate. This contraction is brought about through a simultaneous destruction of 0.44% and creation of 0.17% of tradable jobs.

Most importantly, these results are obtained after controlling for the potential endogeneity of the real exchange rate. In effect, the paper makes use of the substantial autonomous component driving exchange rate movements to identify movements along the tradable industry factor demand curves. As a result, it can rule out supply or technology shocks as an alternative explanation for the results.

Investigating the dynamic response to exchange rate shocks, the paper also finds that exchange rate innovations induce less persistence than aggregate or monetary shocks and represent altogether a smaller source of fluctuations.

The simultaneous increase in job creation and job destruction has important implications. First, it indicates an increase in excess reallocation – the 'churn'– during appreciation episodes. I find that excess job reallocation induced by a 10% appreciation represents 0.34% of tradable employment. Conversely, when the currency is depreciated, traded sector industries experience a 'chill', with lower job creation and destruction rates. Second, interpreting real exchange rate shocks as reallocation shocks, the paper provides useful information on how reallocative shocks propagate through the economy. Reallocation shocks have long been assumed to increase simultaneously *aggregate* job creation and destruction. The novel finding here is that relative price shocks induce a *positive* comovement at the 4-digit industry level. This suggests a cleansing effect that forces both entry and exit margins to comove positively.

The theoretical part of the paper explores the ability of a prototypical 2-sectors non-representative business cycle model to replicate both the aggregate and sectoral results. Since aggregate job creation and destruction comove negatively in the data, there is a tension between positive comovements at the industry level and negative ones at the aggregate level.

The next section provides a detailed motivation. Section 3 presents the empirical results and methodology while section 4 develops a two sectors matching model similar in spirit to Mortensen and Pissarides (1994).

2. MOTIVATION

Figure 1 delivers three messages. First, changes in the nominal exchange rate account for the lion's share of real exchange rate fluctuations. Second, the magnitude of the fluctuations can be quite enormous. Lastly, in due time, those deviations appear to be reversed.

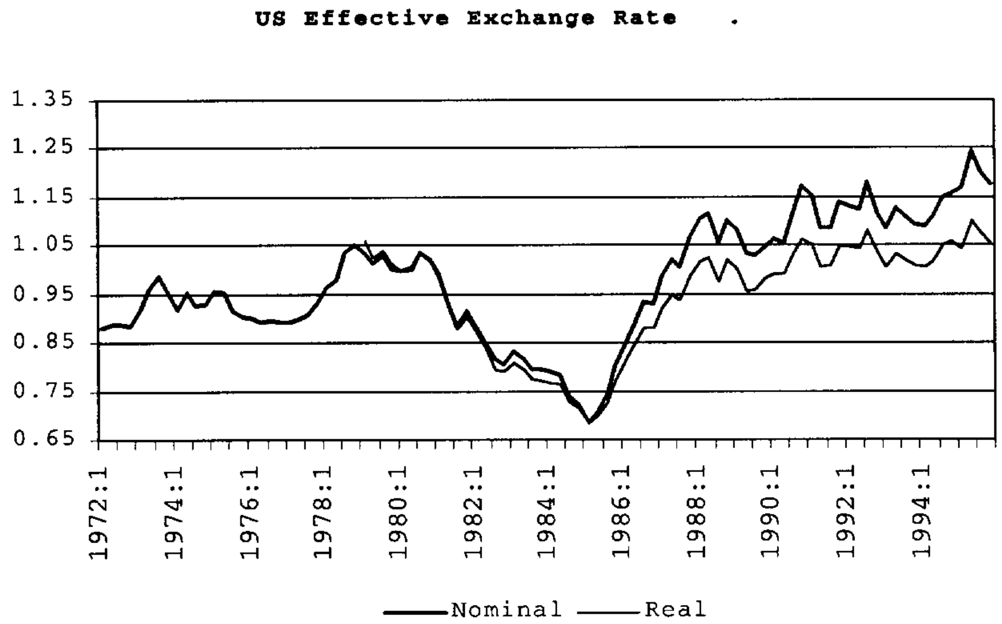

Figure 1: US Nominal and Real Effective Exchange Rate Index (1980:1=1). Source: IFS (series neu and reu)

Such large movements beg two important questions. First and conceptually paramount, is the need to explain the source of these fluctuations. Second, how do firms respond to these shifts in relative prices? I address these questions in the following paragraphs.

2.1. On exchange rates endogeneity. Exchange rate movements are not exogenous. In a trivial way, the nominal exchange rate is the result of the confrontation of a relative demand for, and a relative supply of, currencies. Understanding the determinants of each side of this market has, and still is, the holy grail of International Finance. In the long run, the current account has to be stabilized. At shorter horizons, the nominal exchange rate responds to domestic and foreign monetary conditions. Prices also adjust, as domestic firms may decide to stabilize their export prices in foreign currency (exchange rate pass-through). Both variables along with the nominal exchange rate are determined in a dynamic equilibrium. In standard intertemporal models of exchange rate determination, this implies that movements in the real exchange rate reflect the response of the economy to some fundamental impulses: domestic and foreign monetary policy, supply and technology shocks or aggregate demand. Rather than tracing the impact of the exchange rate shock itself, a natural course of action would consist in evaluating the relative importance of the various impulses directly (Betts and Devereux (1997), Chari, McGrattan and Kehoe (1996), Backus, Kehoe and Kydland (1995)).

Instead, this paper starts with the premise that real exchange rate movements contain an important autonomous component. Before going any further, it is necessary to motivate this approach. A large body of empirical work has aimed to characterize the relationship between the real exchange rate and its fundamental determinants, for instance productivity differentials or real interest rate differentials (de Gregorio, Giovannini and Wolf (1994)). It is widely recognized that this quest has, so far, yielded disappointing results. As Meese and Rogoff (1983) have forcefully demonstrated, the forecasting ability at short to medium horizons (1 quarter to 2 years) of the most refined models falls flat on its face compared with a more parsimonious random walk representation. The simple Mundell-Fleming-Dornbusch model linking real exchange rate depreciation to real interest rates differential does not appear supported by the data (Campbell and Clarida (1987), Meese and Rogoff (1988)), and the empirical evidence in Clarida and Gali (1994) suggests that monetary shocks account for only a third of the variance of real exchange rate one-year-ahead forecast errors. At longer horizons (4 years), Mark and Choi (1997) find more encouraging results and conclude that monetary models retain some predictive power.[1]

Further, numerous empirical studies suggest that real exchange rate deviations from its time-varying equilibrium are not permanent, yet very persistent, with a half-life commonly estimated between 2.5 and 5 years (see Froot and Rogoff (1995) and Rogoff (1996) for a survey). As emphasized by Rogoff (1996), the slow rate at which exchange rate deviations fade away is hard to reconcile with their extreme short run noisiness. In particular, monetary shocks or productivity shocks are unlikely to be the most important source of short run fluctuations. Overall, this indicates that additional sources of fluctuations, beyond the standard determinants postulated in models of exchange rate determination, are at play and dominate over the short to medium term.

[1] Mark (1995) also finds significantly better long horizon (4 years) forecasting power for the nominal exchange rate using a fundamental equation that incorporates domestic and foreign output and money supply.

Such considerations constitute this paper's starting point: exchange rate fluctuations contain an empirically important, if conceptually elusive, source of fluctuations that is independent of the other determinants of the economy (monetary and fiscal policy, technology...). In other words, I use autonomous fluctuations in real exchange rates to identify disaggregated industries' factor demand.

2.2. On micro adjustment, aggregate and reallocation shocks. The real exchange rate represents the relative price of two baskets of goods. Like any relative price, movements in the real exchange rate direct resources to and from specific sectors of the economy. One would, in general, expect large fluctuations in relative prices to have major implications on the relative quantities supplied and demanded. The levels of production, prices and markups, profit margins, input demands and –for exporters– the decision to enter or exit foreign markets, may all be affected by fluctuations in exchange rates. In the traditional 2-sector model with a representative firm in each sector, competitive and frictionless products and good markets, domestic competition for scarce factors of production induces, *ceteris paribus*, a reallocation of factors *across* sectors: following an appreciation of the currency that translates into a lower price for tradables, jobs are destroyed, workers fired and capital dismantled in the traded goods sector, while jobs are created, the same workers hired and the same machines reassembled in the non-traded goods sector. Inputs are continuously reallocated between sectors so as to maintain the economy on its production possibility frontier at all times.

Most previous studies focused on this *net* factor reallocation (Campa and Goldberg (1996) on investment, Branson and Love (1988), Goldberg and Tracy (1998), Burgess and Knetter (1996) on employment), pricing-to-market and sectoral passthrough (Knetter (1993)) or on the static comparison of reallocation levels for exporters and non-exporters (Bernard and Jensen (1995a)).[2]

Non convexities and heterogeneity enrich this picture substantially. Consider first the entry-exit decision in presence of irreversible adjustment costs, and uncertainty about the future value of the exchange rate. Firms may decide to stay invested in a foreign market –and absorb fluctuations in the exchange rate on their profit margin–, or to postpone entry, in the hope that adverse exchange rate movements might be reversed in the near future. Similar arguments apply to the decision to hire workers, invest in new machines, upgrade capital or set prices. Typically, the optimal policy will be one of inaction interspersed with brief adjustment episodes (a generalized (S,s) policy). In a representative firm setting, this optimal inaction region blurs the link between exchange rate movements and reallocation of factors of production. Firms will only enter or leave a market when the exchange rate has deviated sufficiently far away from equilibrium. This indicates a non-linearity presumably hard to document on aggregate data and history dependence (hysteresis). Irreversibilities were advanced as a potential explanation for the continued US trade and current account deficit post 1985. Krugman (1989) concluded provocatively that real exchange rates fluctuate wildly exactly because they do not matter.

However, this conclusion is only valid if the pattern of microeconomic adjustment carries over from the plant or firm level to the sectoral or aggregate one. As recent

[2] Bernard and Jensen (1995b) analyze the entry/exit decision of U.S. manufacturing exporters using plant level data from the Annual Survey of Manufactures (ASM). They conclude that entry costs are relatively small and plant characteristics are crucial. However, by design, they limit their analysis to the binary decision: exporter/non-exporter. This precludes them from looking at import-competing firms. Moreover, as Bernard and Jensen (1995a) discuss, the export measure reported in the ASM only captures direct exports. They calculate that ASM reported exports only account for 70% of exports measured by the Foreign Trade Division at port of exports.

theoretical research demonstrates in the context of price setting or investment dynamics, (Caballero (1992), Caplin and Leahy (1991), Caballero, Engel and Haltiwanger (1997)), this is often not warranted. Heterogeneity across production units contemplating an entry-exit decision will typically tend to smooth out at the aggregate level any sharp microeconomic non-linearities.

One-sector non-representative agent models of reallocation have been recently developed building upon the rich empirical evidence on micro-economic non-convexities and heterogeneity (Mortensen and Pissarides (1994), Ramey and Watson (1997), Caballero and Hammour (1996), Hall (1997b)). These models emphasize the importance of both entry and exit margins to understand critical features of the business cycle uncovered by Davis and Haltiwanger (1990). First, generically, both entry and exit margins are active simultaneously: gross flows are substantially larger than net flows. Second, job destruction plays an essential role in aggregate fluctuations and tends to be concentrated during brief episodes that coincide with sharp downturns in economic activity. Job creation, by contrast, is substantially less volatile over the course of the business cycle. In short, recessions are times of large job destruction and mild decline in job creation. The general challenge, so far, has been to build a theory of aggregate fluctuations that matches these stylized facts.

While existing models all share to some degree the same features, their dynamic and welfare implications differ vastly. In Mortensen and Pissarides (1994) and Cooper, Haltiwanger and Power (1994), firms want to reallocate workers across employment opportunities or engage in nonproduction activities –like search– when aggregate productivity declines. Recessions are times of *cleansing* of the productive structure. In turn, it is also the best time for firms to enter and try to hire new workers. This cleansing effect of recessions explains why destruction is very concentrated, but also implies that destruction and creation are tightly synchronized.[3] As a result, unemployment deviations will typically tend to be short lived.[4]

In Caballero and Hammour (1996), the presence of convex creation costs, in conjunction with contractual inefficiencies, decouples creation and destruction, implying a large built-up of inefficient unemployment in periods of recession. However, match separation is still ex-post efficient, and agreed upon by both the worker and firm. The contractual inefficiency distorts both the first and second moments of the gross flow series and generates countercyclical reallocation.

This reorganization view of recessions is criticized by Ramey and Watson (1997), who argue that recessions do not appear to be good times for job losers. In their model, workers and firms are engaged into a dynamic version of the prisoner's dilemma. While renegotiation is possible, the key assumption is that the match becomes non-viable as soon as one party deviates. Thus matches can be terminated following a negative productivity shock, even though the surplus is still positive, as it becomes harder to prevent either party from deviating. Their model emphasizes the importance of the 'fragile' matches that accumulate close to the cut-off.

Haan, Ramey and Watson (1997) present and calibrate a dynamic general equilibrium model with costly capital adjustment, similar in spirit to Mortensen and Pissarides (1994). Their model emphasizes the interaction between endogenous job destruction and capital accumulation as a source of additional persistence. As more jobs are destroyed, the marginal product of capital decreases. The endogenous response of the economy is a decline in investment, to restore the marginal product of cap-

[3]See Caballero and Hammour (1996) for a discussion of the importance of timing assumptions for the correlation between job creation and job destruction.

[4]See Cole and Rogerson (1996) for developments on this point.

ital. However, lower investment triggers secondary waves of separation that further depress the marginal product of capital and induce considerably more unemployment persistence.

Hall (1997b) also points out the theoretical and empirical importance of the discount rate for the economics of the shutdown margin. In his model, firms will decide to liquidate their inventories and reduce their workforce simultaneously when the value of output is high and expected to decline. In general equilibrium, recessions are associated with a high Arrow-Debreu time 0 price of output, or equivalently, with a high interest rate.

These models are quite successful at explaining how aggregate shocks can match the Davis-Haltiwanger (1990) stylized facts. Yet, they restrict their attention to the dynamic response to *aggregate* productivity or demand shocks. A natural question, within that framework, is the extent and pattern of excess reallocation induced by exchange rate movements. While real exchange rate movements may exert pressure to relocate factors of production *across* sectors, they will also influence the pattern of reallocation *within* narrowly defined sectors and industries. This paper, analyzes *inter* and *intra* sectoral dynamic reallocation patterns in response to both aggregate and reallocation shocks.

Moreover, existing empirical work using structural VAR-based variance decompositions generally concludes that standard impulses (technology shocks, government expenditures or monetary policy) do a poor job at explaining the volatility of aggregate output (Cochrane (1994) and Hall (1997a),(1997b)). Reallocation shocks –usually interpreted as the result of sectoral-specific technology shocks, or relative demand shifts– have long been another prime candidate to explain aggregate fluctuations, following the seminal work of Lilien (1982).[5] Davis and Haltiwanger (1996), using gross job flows and long run restrictions to identify the relative importance of aggregate and reallocative shocks in the US economy conclude that the latter represent the major source of job reallocation. Campbell and Kuttner (1996) reach a similar conclusion looking at fluctuations in sectoral employment shares. On the other hand, Caballero et al. (1997), using micro data on employment adjustment, conclude that the bulk of average employment and job destruction fluctuations is accounted for by aggregate rather than reallocation shocks, while job creation reacts strongly to allocative shocks.[6]

Both arguments suggest that a first order of business consists in establishing more structural correlations between primitive disturbances and measures such as gross flows. Davis and Haltiwanger (1997) explore this avenue in the context of oil shocks. This paper presents an attempt in the same direction using exchange-rate fluctuations as the main driving force, and attempts to uncover the nature and importance of these adjustment patterns using a rich disaggregated data set of US manufacturing plants.

To do so, I trace back sectoral fluctuations to exogenous movements in the real exchange rate and then develop a prototypical 2-sector non-representative agent business cycle model (with tradable and nontradable goods) to explore the ability of the model to replicate salient features of the data. In practice, the problem consists in mapping gross flow movements to exogenous real exchange rate fluctuations.

This is difficult for two different, but related, reasons. First, as noted above, exchange rates move in reaction to changes in monetary or aggregate conditions, making

[5]See Lilien (1982), Abraham and Katz (1986), and Blanchard and Quah (1989).

[6]In the context of non-representative agent models, reallocation shocks are often modelled as a mean preserving spread on the cross-section distribution of idiosyncratic shocks, in a one-sector economy.

inference difficult. It is precisely in order to avoid similar problems that a number of papers use oil shocks as an exogenous source of disturbance (Davis and Haltiwanger (1997), Campbell and Kuttner (1996)). Second, as Bernanke, Gertler and Watson (1997) argue, in the context of oil shocks, the economy's response to exchange rate innovations may also reflect the endogenous response of monetary policy to the initial disturbance. While the original impulse can be thought of as exogenous, it is not possible, without additional identification assumptions, to separate the direct effect of exchange rate shocks from the expected monetary policy response. This problem is more severe the more likely monetary policy reacts to the original disturbance. Arguably, this may not be too mcuh of a problem in the case of the US, to the extent that monetary policy is set largely independently of the exchange rate.[7] I will allow for exchange rate innovations to feed back on monetary policy so that the responses should be thought of as a combination of the response to exchange exchange innovations and as well as the expected implied monetary response.

3. EXCHANGE RATES AND GROSS FLOWS

This section investigates the response of gross and net employment flows to exchange rate fluctuations. This requires an operational definition of tradables and nontradables, a measure of gross flows, and a real exchange rate. I start with a description of the data construction, then discuss the empirical specification and results. I look

[7]Since 1985, and the abrupt policy shift of the Reagan administration, the Fed has intervened more systematically on foreign exchange market, sometimes in concertation with partner central banks. These interventions, however, are mostly *sterilized*, implying an offsetting action at the open market window and unchanged money supply or interest rates.

at both net and gross employment changes using quarterly disaggregated data for US manufacturing from 1972 to 1988. The focus on manufacturing is largely dictated by the availability of gross flow data. While this excludes services, arguably an important component of nontradables, it will soon become apparent that finely disaggregated manufacturing industries exhibit substantial variation in terms of international exposure that allows identification of exchange rate effects.

3.1. The data.

3.1.1. Tradable and Nontradable industries. I first allocate 4-digit industries into a traded, a nontraded and a residual group. This exercise aims at measuring the exposure of disaggregated US manufacturing industries. Campa and Goldberg (1995) identify three distinct channels through which an industry is exposed to exchange rate fluctuations: export revenues as a share of the industry's revenues, the extent of import competition, and lastly the cost of imported inputs. I abstract from the last measure, which would require use of an input-output table, and concentrate on export shares and import penetration ratio.[8] While the definition of traded good industries is relatively straightforward (if we observe sufficient levels of trade in some good, then it must be traded), this is not the case for nontradables. An industry might be fully integrated internationally, yet experience very low levels of exports and imports. Luckily, this problem is only likely to classify spuriously some tradable indus-

[8]There are reasons to believe that omitting imported inputs may not bias seriously the results since the direction of the effect is likely to be the same as for nontraded industries, that is, an appreciation leads to a relative gain in profitability through a decline in input costs. The bias is likely to be more serious if industries classified as traded based on their output are in fact very cost sensitive to exchange rate fluctuations.

tries as nontradable, which biases the results towards zero.[9] Using the NBER Trade database, I adopt the following operational definition of tradable and nontradable industries. First, I calculate for each 4-digit industry and every year in the sample the export share and import penetration ratios. Then I classify an industry as traded if *either* the export share exceeds 13% *or* the import penetration ratio exceeds 12.5% *in all the years of the sample.* Conversely, an industry is classified as non-traded when either (1) the export share is lower than 1.3% and the import penetration ratio is lower than 6.8% *in all years in the sample* or (2) the export share is lower than 5.8% and the import penetration is less than 0.8%, *in all years in the sample.* All other sectors are discarded.[10] This selection criterion ensures that sectors experiencing a transition from very closed to very open or vice versa are excluded from the sample. 48 sectors are initially identified as nontraded and 69 as traded, out of a total of 450 4-digit manufacturing sectors. Based on the NBER trade database, I further exclude all sectors without detailed information on exports and imports by country of destination or origin. The final list includes 35 nontraded sectors and 68 traded ones. Tradable industries are further classified as exporters or import-competing according to their export share and import penetration ratios. Out of the 68 traded industries (with some overlap), 34 are classified as exporters and 39 as import-competing sectors. The list of industries with their SIC code, average export share, import penetration and share of the 2 digit industry labor force is reported in the appendix (table 12 and 13).

Looking at the tables, a few points emerge. First, nontradables are concen-

[9] An alternative would be to compare domestic and foreign prices. Foreign prices for exported and imported goods are relatively difficult to find.

[10] The values for the export shares and import penetration ratios cut-offs are similar to the ones used in Davis, Haltiwanger and Schuh (1996).

trated primarily in nondurables, where they represent around 23% of employment. By comparison, nontradables represent only 6.6% of durable manufacturing employment. Overall, nontradable goods are either perishable such as food products and newspapers, or heavy durable goods, such as concrete, bricks or stone, for which transportation costs are prohibitive. Conversely, tradables tend to be concentrated in durable goods industries, with an average share of employment of 21.4%.[11] Major exporting 2-digit industries, measured in terms of employment, include Non-electrical Machinery (SIC 35, 41%), Transportation Equipment (SIC 37, 27%) and Instruments (SIC 38, 8%). Lastly, it is worth noting that import-competing industries represent quite a small fraction of total manufacturing employment (around 11%) and tend to be concentrated in Paper (SIC 26, 14%), Leather (SIC 31, 15%), and especially Motor Vehicles (SIC3711, 31%).[12]

Table 1 also reports some characteristics for industries grouped according to the previous classification.[13] We observe that traded goods producers tend, on average, to be more capital intensive, to pay higher wages, to be smaller and to have slightly higher total factor productivity. Looking at exporting versus import-competing sectors, we observe that exporters pay higher wages, tend to be larger in terms of shipments or number of employees, more capital intensive and more productive (as measured by TFP).

[11]This number differs slightly from the sum of the shares for exporters and import-competing since some sectors, such as Paper Industries Machinery (SIC 3554) or Sewing Machines (SIC 3636) are both import competing and exporting.

[12]See the appendix.

[13]The data is taken from the NBER Productivity database. See Bartelsman and Gray (1996) for a description.

Table 1: CHARACTERISTICS OF NON-TRADED, TRADED, EXPORTERS AND IMPORT-COMPETING FIRMS

Variable	All	Non-Traded	Traded		
			All	Exporters	Import-Competing
Capital:					
per production worker	89.92	75.51	102.47	125.29	95.93
per worker	63.16	50.20	70.23	82.02	69.51
Investment					
per production worker	27.75	20.70	43.74	55.07	33.15
per worker	19.56	14.95	29.62	35.62	23.96
Employment					
production worker	29.14	31.65	27.32	31.49	21.24
Total employment	40.46	49.13	41.37	53.93	26.48
Shipments	4784	5784	5689	5985	4920
TFP (%)	0.57	0.46	0.48	0.65	0.41
Materials intensity (%)	51.41	51.46	52.97	51.23	54.03
Energy Intensity (%)	2.56	2.18	2.41	2.13	2.77
Wages					
production workers	19.42	18.33	20.06	23.23	17.53
total	22.01	20.70	23.03	26.76	19.96

Note: Capital, investment, shipments and wages, thousands of 1987 dollars; Employment: thousands; Materials intensity: materials expenditures/shipment; Energy intensity: energy expenditures/shipment. Source: NBER productivity database and author's calculations.

3.1.2. Gross Flows. Quarterly sectoral data on job creation and job destruction is tabulated by Davis and Haltiwanger (1990) for both 2-digit and 4-digit industries.[14] This data is constructed from the Census's Longitudinal Research Database, and covers US manufacturing over the period 1972:2-1988:4.[15]

[14] I thank John Haltiwanger for providing the sectoral data through his ftp site.

[15] This dataset is now widely used in macro and labor studies and I refer the reader to Davis, Haltiwanger and Schuh (1996) for a detailed description. Two points are worth noting. First, the timing of quarters is non-standard with quarter 1 of year t running from November of year $t-1$ to February of year t. Second, the SIC underwent substantial changes in 1987. Davis and Haltiwanger data report sectoral job creation and destruction using the SIC72 classification for 1972-1986 and the SIC87 classification for 1987-1988. The last two years of data were spliced into the SIC72 classification using the concordance table provided in Bartelsman and Gray (1996).

Using the previous classification, I first aggregate gross flows for traded, nontraded, exporters and import-competing sectors. Table 2 reports descriptive statistics for the resulting gross and net flows. The main points are as follows. First, net employment growth is negative for all groups, reflecting the declining importance of manufacturing employment in the US economy. This downward trend is especially marked for import-competing industries with an average annual employment decline of 0.62%. Second, defined tradable and nontradables represent roughly similar shares of total manufacturing employment, around 13% . This indicates that the bulk of manufacturing employment cannot be classified as either traded or non-traded according to our criterion. Third, for all sectors, job destruction exhibits more volatility than job creation. Furthermore, creation and destruction are proportionately more volatile for tradable industries. Taken together, these results indicate a larger level of "turbulence" in the traded goods sector. This paper explores the link between this turbulence and exchange rate exposure. Lastly, as pointed out by Foote (1995), one should expect industries with a marked downward employment trend to exhibit a larger volatility of job destruction, as the exit margin is 'hit' more frequently while the industry shrinks. One finds indeed that the job destruction rate is both higher and more volatile for import-competing industries.

3.1.3. Real Exchange Rate. The last ingredient for the analysis is the real exchange rate. I use an *industry-based* definition of the real exchange rate, constructed as a trade-weighted log-average of bilateral WPI-based real exchange rates. The trade weights are industry specific and constructed from the NBER trade database which includes, for each 4 digit industry, annual data on shipments, exports and imports, disaggregated by country of destination (exports) or origin (imports). The industry

Table 2: GROSS FLOWS BY SECTORS

	Job Creation				Job Destruction			
Sector	*Mean*	*Standard Deviation*	*Min.*	*Max.*	*Mean*	*Standard Deviation*	*Min.*	*Max.*
Non-traded	5.48	0.79	4.04	7.54	5.67	1.02	3.46	8.61
Traded	5.36	0.96	3.16	7.50	5.76	1.68	3.04	10.85
Exporters	4.82	1.06	2.55	7.51	5.00	1.69	2.29	10.05
Import-comp.	6.01	1.55	2.86	9.84	6.64	2.68	3.44	16.27
	Excess Reallocation				Net Employment Growth			
	Mean	*Standard Deviation*	*Min.*	*Max.*	*Mean*	*Standard Deviation*	*Min.*	*Max.*
Non-traded	10.16	1.20	6.93	12.50	-0.19	1.29	-3.88	2.80
Traded	9.38	1.53	6.09	13.76	-0.39	2.28	-7.69	3.41
Exporters	8.08	1.83	4.58	15.01	-0.18	2.21	-6.21	3.64
Import-comp.	10.29	2.19	5.72	16.46	-0.62	3.26	-10.42	4.06
	Manufacturing Employment Share							
	Mean	*Standard Deviation*	*Min.*	*Max.*				
Non-Traded	12.11	0.45	11.32	12.95				
Traded	14.54	0.32	13.70	15.27				
Exporters	8.48	0.62	7.29	9.59				
Import-comp.	6.41	0.6	5.36	7.50				

Source: gross flows from Davis and Haltiwanger, LRD; and author's calculations.

specific log real exchange rate is then a weighted average of the WPI-based log-real exchange rate against *that sectors*' major trading partners.[16]

[16]For the purpose of this paper, I define the major trading partners by calculating the average export/import shares of total export/import for each industry and destination/origin country. Country i is considered a major trading partner for industry j if either (1) country i is among the largest trading partners accounting for the first 50% of exports/imports for industry j or (2) trade with country i represents more than 10% of exports/imports, on average over the sample period. The real exchange rate is then constructed as a log average using export/import shares as weights. For each industry, the real exchange rate is normalized to 100 in 1987:4. Data on WPI and nominal exchange rates was obtained from the International Financial Statistics Database. China, Irak, Hong-Kong, Taiwan and the United Arab Emirates were deleted as trading partners since no reliable data on bilateral real exchange rate was available.

For the appropriate sectors, both an export and an import based sectoral real exchange rate are created in this fashion. A similar methodology is also used to construct real exchange rate indices for each of the 2 digit industries and for nontradable industries, whenever data on exports and imports are available.[17]

Figure 2 report the real exchange rate index for some 2-digit industries. At this level of aggregation, the figure reveals a similar broad pattern in all industries, with a significant real appreciation during the first half of the eighties corresponding to the nominal appreciation of the dollar, and a rapid depreciation from 1985 onwards. Note however, that the figures do exhibit substantial variation in terms of timing and amplitude. For instance, Furnitures (SIC 25) experienced a rapid real depreciation between 1972 and 1977, while Textiles' real exchange rate (SIC 22) remained relatively unchanged until the late 1980. This sectoral variation will help identification.

3.2. Empirical results. In this section, I consider first the reduced form response of gross and net flows to exchange rate movements. Issues of simultaneity are discussed and controlled for. I then present dynamic structural estimation based on a VAR decomposition.

3.2.1. Reduced form estimation. One can think of the approach of this sub-section as mapping an industry factor demand curve from movements in the real exchange rate. I start with the direct estimation results for net and gross job flows and then discuss simultaneity issues and instrumentation.

Net Employment Changes. Given the definitions adopted, nontraded industries play the role of a control group: their international exposure is limited, and their response to exchange rate fluctuations should be minimal. On the other hand, an

[17]Trade data on all 4-digit sectors was used to construct weights at the 2 digit.

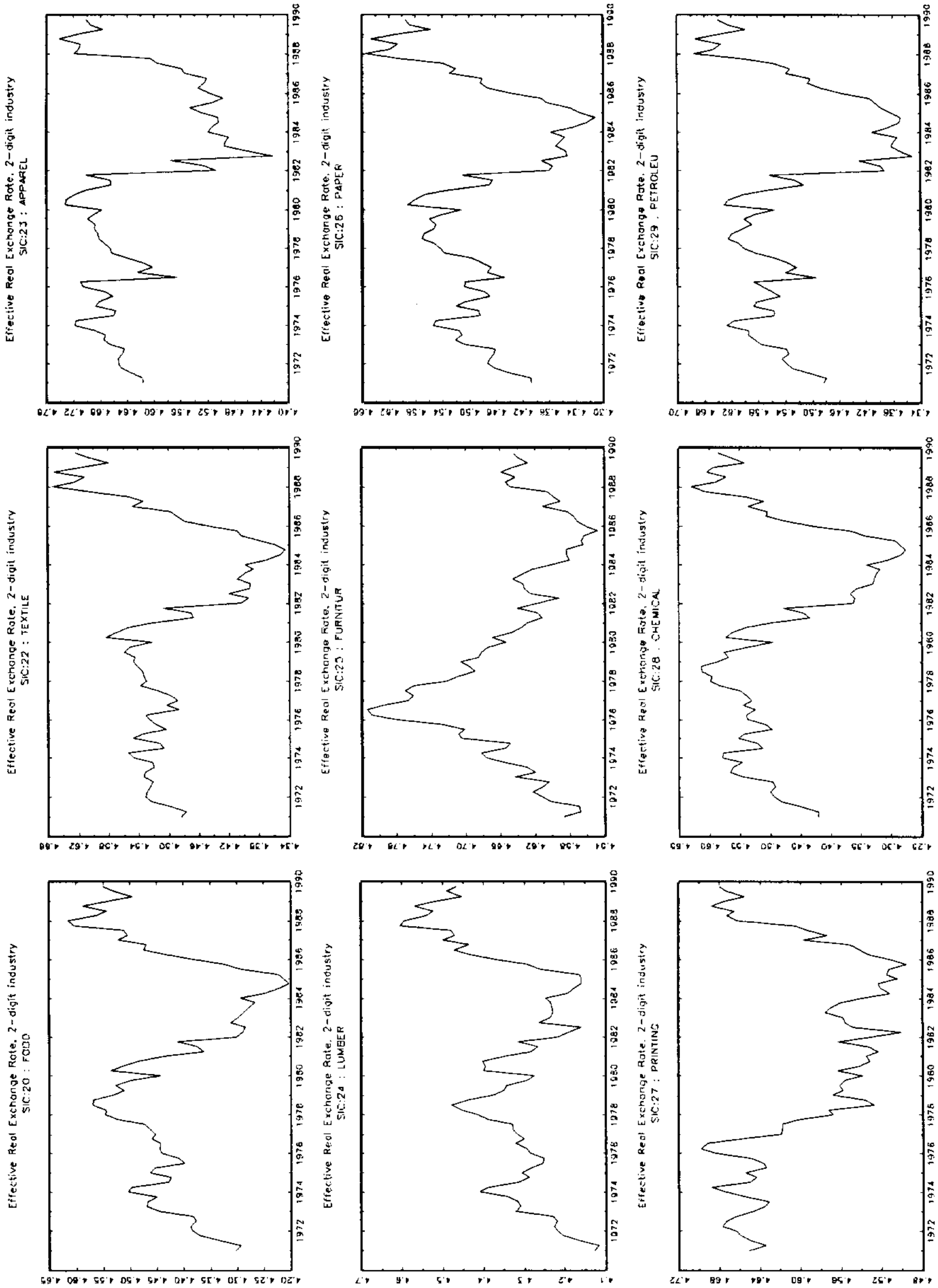

Figure 2: SIC-2 log real exchange rate. 1987Q4 = ln 100

appreciation of the real exchange rate should induce a reallocation of factors away from the traded good sector. That is, each traded industry's employment level should respond negatively to an appreciation of its real exchange rate. In turn, the decline in employment can result from a decline in job creation or an increase in job destruction. At the aggregate level, there is overwhelming evidence that the adjustment takes place along the exit margin.

I investigate each question in turn. Starting with net employment changes, I evaluate the amount of intersectoral reallocation that is induced by the exchange rate. I then turn to the gross flows.

Consider the following specification:

$$\hat{E}_{it} = \alpha_i + \beta(L)\lambda_{it} + \gamma(L)Z_t + \epsilon_{it} \tag{1}$$

where $\hat{E}_{it}$ is net employment growth in industry i between time $t-1$ and t, and λ_{it} is the deviation from trend of the industry specific log real exchange rate. Z_t contains aggregate variables likely to influence both the real exchange rate and employment growth. I include in Z_t total manufacturing employment growth $\hat{E}_t$, to capture the effect of aggregate shocks, as well as the federal funds rate, i_t. $\beta(L)$ and $\gamma(L)$ are lag polynomials. They are allowed to vary across groups: nontraded, traded, exporters and import-competing. The results are presented in panel A of Table 3.

Under the null hypothesis that all variations in employment growth are unrelated to real exchange rate fluctuations, the real exchange rate should have no explanatory power. The table indicates that a depreciated exchange rate has a small effect on tradable employment growth.[18] A 10 percent depreciation of the exchange rate (a

[18]Note that equation (1) is a growth-level relation with the industry employment growth on the

Table 3: EMPLOYMENT RESPONSE TO REAL EXCHANGE RATE DEVIATIONS

EMPLOYMENT GROWTH

PANEL A: DIRECT ESTIMATION											
Sector:		2 digit		Traded						Non-Traded	
				All		Exports		Import comp.			
Regressor	Timing	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
λ_t	cont.	1.40	1.65	4.97	2.47	2.72	3.32	4.58	3.18	6.24	3.38
	1 lag	-0.64	2.29	5.47	3.40	2.60	4.70	8.24	4.32	-3.13	4.45
	2 lags	-0.37	1.76	-7.73	2.58	-4.28	3.49	-9.84	3.31	-0.92	3.49
	Sum:	0.39	0.76	2.71	1.13	1.03	1.38	2.96	1.03	2.18	1.88
$\hat{E}_t$	cont.	0.68	0.03	0.66	0.06	0.48	0.07	0.77	0.08	0.52	0.08
	1 lag	0.01	0.04	0.08	0.06	0.12	0.08	0.03	0.08	0.02	0.08
	2 lags	0.17	0.03	0.28	0.05	0.37	0.07	0.18	0.07	0.06	0.07
	Sum:	0.85	0.04	1.02	0.07	0.98	0.10	0.98	0.10	0.60	0.10
i_t	cont.	0.05	0.03	0.05	0.05	0.18	0.07	-0.08	0.07	-0.03	0.07
	1 lag	-0.12	0.03	-0.05	0.06	-0.10	0.08	0.01	0.08	-0.06	0.08
	2 lags	0.02	0.03	0.01	0.06	-0.07	0.07	0.04	0.08	0.07	0.07
	Sum:	-0.06	0.02	0.01	0.03	0.01	0.05	-0.03	0.04	-0.01	0.04
PANEL B: 2SLS											
Sector:		2 digit		Traded						Non-Traded	
				All		Exports		Import comp.			
Regressor	Timing	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
λ_t	cont.	6.34	1.76	-0.42	2.41	1.65	3.03	-3.15	3.23	3.81	3.89
	1 lag	-6.15	2.05	5.34	2.86	1.96	3.61	8.48	3.84	-3.68	4.62
	2 lags	0.21	1.67	-3.44	2.34	-3.12	2.95	-4.86	3.14	0.12	3.85
	Sum:	0.39	1.47	1.47	1.87	0.49	2.24	0.47	2.58	0.25	3.12
$\hat{E}_t$	cont.	0.70	0.03	0.64	0.06	0.47	0.07	0.76	0.08	0.51	0.08
	1 lag	0.01	0.04	0.06	0.06	0.12	0.08	0.01	0.09	0.02	0.08
	2 lags	0.17	0.03	0.29	0.05	0.37	0.07	0.19	0.07	0.07	0.07
	Sum:	0.88	0.04	1.00	0.08	0.96	0.10	0.96	0.11	0.60	0.11
i_t	cont.	0.04	0.03	0.03	0.05	0.16	0.07	-0.10	0.07	-0.03	0.07
	1 lag	-0.11	0.03	-0.05	0.06	-0.09	0.08	0.01	0.08	-0.07	0.08
	2 lags	0.03	0.03	0.01	0.06	-0.06	0.07	0.01	0.08	0.07	0.08
	Sum:	-0.04	0.02	-0.02	0.03	-0.01	0.05	-0.08	0.05	-0.03	0.05

Note: The table shows the response of employment growth to deviations of the real exchange rate from trend for each sector (λ), changes in total manufacturing employment growth $\left(\hat{E}\right)$ and the Federal Fund rate i_t. The coefficients are constrained to be equal across sectors, except for a constant (not shown). The first column reports the results for all 2-digit industries. The remaining columns report the result for 4 digit tradables, exporters, import-competing, and nontradables. Panel A reports fixed effect estimation. Panel B instruments the real exchange rate with the Hall-Ramey instruments (Hall (1988)): military expenditure growth, crude oil price growth, political party of the President. Observations are quarterly, 1972:2 to 1988:4. Source: net employment change from Davis and Haltiwanger (1990), LRD; real exchange rate: author's calculations.

high value of λ) leads to an increase of tradable manufacturing employment of 0.27%.[19] Nontradable employment appears unresponsive to exchange rate movements (with a sum of coefficients equal to 2.18 and a standard error of 1.88). However, note that the point estimates arefor tradable and nontradable are close together and one cannot reject the hypothesis that they are equal. Further, comparing export and import-competing industries, it appears that the effect comes mostly through an employment increase in import-competing industries. These reduced form results indicate a limited amount of intersectoral reallocation. Looking at individual coefficients, it appears that employment growth increases for the first 2 quarters, then declines.

The coefficients on total manufacturing employment growth $\hat{E}_t$, are large, significant, and their sum is close to 1 for all sectors but nontraded, indicating that shocks that affect total manufacturing employment growth are reflected almost one for one into sectoral employment growth. Somewhat surprisingly, it appears that monetary policy does not influence markedly industry employment growth, once we control for fluctuations in total manufacturing employment. [20]

To summarize, the results indicate limited intersectoral reallocation of labor in

left hand side and the real exchange rate deviation from trend on the other side.

[19]A caveat on reading the regression results: a coefficient of α for the real exchange rate coefficient implies that a 1% depreciation will increase employment growth by $\alpha/100\%$. A coefficient of β on aggregate employment growth implies that a 1% increase in growth rates will increase sectoral employment growth by $\beta\%$.

[20]In unreported regressions, I also included the Hamilton oil price index (Hamilton (1996)) or a commodity price index as another control. The results were unchanged and the oil price index was never significant. Results are also unchanged if one uses the spread between 6 months commercial paper and 6 months T-bill instead of the Federal Funds rate. Similar results are also obtained when using the import based real exchange rate or using the absolute level of the real exchange rate instead of the deviations from trend.

response to exchange rates. We turn now to the next question: is the increase in employment coming from an increased creation, a decrease in job destruction, or a combination?

Gross employment changes. To answer this question, I now run the exact same specification, replacing industry net employment growth successively with job destruction rates and job creation in equation (1). The results are presented in panel A of Tables 4 and 5.

The results indicate the following:

- Gross flows in the nontraded good sector are insensitive to exchange rate movements. They are, however, very sensitive to aggregate shocks, as captured by total manufacturing employment growth. Thus our definition of nontradable seems relevant as a control group;

- Traded sectors job destruction rates are quite sensitive to exchange rate movements. A 10% real depreciation destroys 0.44% of tradable employment. With an average quarterly job destruction rate around 5.3%, this represents a very sizeable response to relatively minor exchange rate fluctuations;

- Job destruction in both sectors covaries negatively and significantly with aggregate shocks;

- Irrespective of the shock, job destruction is more responsive than job creation in all sectors.

- Tradable job creation declines mildly in response to a depreciation of the exchange rate (-0.17% for 10% depreciation) and increases in response to a positive aggregate shock;

Table 4: JOB DESTRUCTION RESPONSE TO REAL EXCHANGE RATE DEVIATIONS

JOB DESTRUCTION

PANEL A: DIRECT ESTIMATION

Sector:		2 digit		Traded						Non-Traded	
				All		Exports		Import comp.			
Reg.	Timing	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
λ_t	cont.	-2.88	1.25	-4.26	1.82	-1.56	2.39	-4.99	2.40	-5.27	2.22
	1 lag	-2.13	1.74	-8.65	2.51	-7.19	3.39	-10.23	3.25	0.58	2.93
	2 lags	3.43	1.34	8.46	1.91	6.06	2.52	10.27	2.49	4.21	2.30
	Sum:	-1.58	0.57	-4.44	0.83	-2.68	0.99	-4.95	1.15	-0.47	1.24
$\hat{E}_t$	cont.	-0.45	0.02	-0.40	0.04	-0.26	0.05	-0.50	0.06	-0.33	0.05
	1 lag	-0.03	0.03	-0.10	0.05	-0.11	0.06	-0.10	0.06	-0.01	0.06
	2 lags	-0.16	0.02	-0.23	0.04	-0.27	0.04	-0.16	0.05	-0.06	0.05
	Sum:	-0.65	0.03	-0.73	0.05	-0.65	0.07	-0.75	0.08	-0.39	0.07
i_t	cont.	-0.07	0.02	-0.10	0.04	-0.20	0.05	-0.01	0.05	-0.01	0.05
	1 lag	0.08	0.02	0.06	0.04	0.09	0.05	0.02	0.06	0.03	0.05
	2 lags	0.01	0.02	0.01	0.04	0.05	0.05	-0.01	0.06	-0.01	0.05
	Sum:	0.01	0.01	-0.03	0.02	-0.05	0.03	0.01	0.03	0.01	0.03

PANEL B: 2SLS

Sector:		2 digit		Traded						Non-Traded	
				All		Exports		Import comp.			
Reg.	Timing	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
λ_t	cont.	-0.69	1.36	-2.02	1.76	-4.05	2.11	0.38	2.45	1.21	2.57
	1 lag	0.98	1.59	-4.99	2.09	-4.72	2.52	-5.59	2.91	-1.38	3.05
	2 lags	-1.58	1.28	1.46	1.72	3.45	2.06	1.68	2.38	2.49	2.54
	Sum:	-1.29	1.13	-5.54	1.37	-5.31	1.56	-3.53	1.95	2.33	2.06
$\hat{E}_t$	cont.	-0.46	0.02	-0.40	0.04	-0.27	0.05	-0.50	0.06	-0.33	0.05
	1 lag	-0.02	0.03	-0.08	0.05	-0.11	0.06	-0.06	0.06	0.01	0.06
	2 lags	-0.17	0.02	-0.24	0.04	-0.27	0.05	-0.19	0.05	-0.08	0.05
	Sum:	-0.65	0.03	-0.73	0.06	-0.65	0.07	-0.76	0.08	-0.41	0.07
i_t	cont.	-0.05	0.02	-0.07	0.04	-0.16	0.05	0.03	0.05	-0.01	0.05
	1 lag	0.07	0.02	0.05	0.04	0.08	0.05	0.02	0.06	0.04	0.05
	2 lags	0.01	0.02	0.01	0.04	0.03	0.05	0.01	0.06	0.01	0.05
	Sum:	0.02	0.02	-0.01	0.03	-0.05	0.03	0.05	0.04	0.04	0.03

Note: The table shows the response of Job Destruction to deviations of the real exchange rate from trend for each sector (λ), changes in total manufacturing employment growth $\left(\hat{E}\right)$ and the Federal Fund rate i_t. The coefficients are constrained to be equal across sectors, except for a constant (not shown). The first column reports the results for all 2-digit industries. The remaining columns report the result for 4 digit tradables, exporters, import-competing, and nontradables. Panel A report fixed effect estimation. Panel B instruments the real exchange rate with the Hall-Ramey instruments (Hall (1988)): military expenditure growth, crude oil price growth, political party of the President. Observations are quarterly, from 1972:2 to 1988:4. Source: employment from Davis and Haltiwanger (1990), LRD; real exchange rate: author's calculations.

Table 5: JOB CREATION RESPONSE TO REAL EXCHANGE RATE DEVIATIONS

JOB CREATION

PANEL A: DIRECT ESTIMATION

Sector:		2 digit		Traded						Non-Traded	
				All		Exports		Import comp.			
Reg.	Timing	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
λ_t	cont.	-1.43	0.99	0.71	1.44	1.16	2.04	-0.41	1.79	0.97	2.16
	1 lag	-2.86	1.37	-3.17	1.99	-4.58	2.90	-1.99	2.43	-2.54	2.85
	2 lags	3.20	1.05	0.72	1.51	1.77	2.15	0.42	1.86	3.29	2.24
	Sum:	-1.09	0.45	-1.73	0.60	-1.64	0.65	-1.98	0.56	1.71	1.31
$\hat{E}_t$	cont.	0.22	0.02	0.26	0.03	0.22	0.04	0.28	0.04	0.19	0.05
	1 lag	-0.02	0.02	-0.02	0.04	0.01	0.05	-0.07	0.05	0.01	0.06
	2 lags	0.01	0.02	0.06	0.03	0.09	0.04	0.02	0.04	-0.01	0.05
	Sum:	0.21	0.02	0.29	0.04	0.33	0.06	0.23	0.06	0.20	0.07
i_t	cont.	-0.03	0.02	-0.05	0.03	-0.02	0.04	-0.08	0.04	-0.04	0.05
	1 lag	-0.04	0.02	0.01	0.03	-0.04	0.05	0.03	0.04	-0.03	0.05
	2 lags	0.02	0.02	0.02	0.03	-0.02	0.04	0.02	0.04	0.06	0.05
	Sum:	-0.05	0.01	-0.03	0.02	-0.04	0.03	-0.04	0.03	-0.01	0.03

PANEL B: 2SLS

Sector:		2 digit		Traded						Non-Traded	
				All		Exports		Import comp.			
Reg.	Timing	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
λ_t	cont.	5.61	1.05	-2.44	1.39	-2.40	1.84	-2.77	1.79	5.02	2.49
	1 lag	-5.11	1.23	0.35	1.65	-2.76	2.19	2.89	2.14	-5.05	2.96
	2 lags	-1.37	0.99	-1.97	1.35	0.33	1.80	-3.18	1.75	2.62	2.46
	Sum:	-0.86	0.88	-4.07	1.07	-4.83	1.36	-3.05	1.43	2.58	1.99
$\hat{E}_t$	cont.	0.24	0.02	0.24	0.03	0.21	0.04	0.25	0.04	0.18	0.05
	1 lag	-0.01	0.02	-0.02	0.04	0.01	0.05	-0.05	0.05	0.03	0.05
	2 lags	-0.01	0.02	0.05	0.03	0.09	0.04	0.01	0.04	-0.01	0.04
	Sum:	0.22	0.03	0.27	0.04	0.31	0.06	0.20	0.06	0.19	0.06
i_t	cont.	-0.02	0.02	-0.04	0.03	0.01	0.04	-0.07	0.04	-0.04	0.04
	1 lag	-0.04	0.02	0.01	0.03	-0.01	0.05	0.02	0.04	-0.03	0.05
	2 lags	0.04	0.02	0.01	0.03	-0.04	0.04	0.02	0.04	0.07	0.05
	Sum:	-0.02	0.01	-0.03	0.02	-0.05	0.02	-0.03	0.03	0.01	0.03

Note: The table shows the response of Job Creation to deviations of the real exchange rate from trend for each sector (λ), changes in total manufacturing employment growth $(\hat{E})$ and the Federal Fund rate i_t. The coefficients are constrained to be equal across sectors, except for a constant (not shown). The first column reports the results for all 2-digit industries. The remaining columns report the result for 4 digit tradables, exporters, import-competing, and nontradables. Panel A report fixed effect estimation. Panel B instruments the real exchange rate with the Hall-Ramey instruments (Hall (1988)): military expenditure growth, crude oil price growth, political party of the President. Observations are quarterly, from 1972:2 to 1988:4. Source: employment from Davis and Haltiwanger (1990), LRD; real exchange rate: author's calculations.

- import-competing industries appear more sensitive to exchange rate fluctuations then exporters;

This last point indicates that gross flows depict a somewhat different picture than net flows for exporters and import-competing industries. In export-oriented industries, an appreciation is associated with a substantial increase in job destruction and creation that leaves, on net, employment unchanged.

The apparent similarity between the point estimates of net employment for traded and nontraded sectors disappears when looking at gross flows. The contrast between the two groups indicates that the results are not driven by a response to aggregate disturbances. Further, it appears that the dynamic adjustment to a relative price shock is quite different from the adjustment to an aggregate shock. Following an aggregate shock, job creation and destruction move *in opposite direction.* However, following an exchange rate shock, job creation and destruction move *in the same direction.* While reallocative shocks are often assumed to induce a simultaneous increase in aggregate job creation and destruction, it is worthy to note that the simultaneous move occurs *within* the tradable sector, unlike the intersectoral channels sometimes emphasized in the literature. A similar result is obtained by Davis and Haltiwanger (1997) in response to oil shocks.

By contrast, a positive aggregate shock increases job creation by 0.29 (resp. 0.20) in the traded (resp. nontraded) sector and a decline in job destruction of 0.73 (resp. 0.39).

How much does each margin contribute to industry employment adjustment? Clearly, given our estimates, job destruction plays the major role, with job creation as a follower. The results also indicate that excess reallocation or 'churn' will increase when the exchange rate appreciates, and decrease when the currency depreciates. Hence, the next point:

- Appreciations are associated with increased turbulence on the labor market. Job creation, destruction and excess reallocation increase. Conversely, during depreciations phases, the tradable sector 'chills' as creation and destruction rates fall.

Note that the paper does not draw any welfare implications at this stage, and that this 'chill' does not follow a burst of destruction, as in Caballero and Hammour (1998)

.

Simultaneity and Choice of Instrumental Variables. The preceding empirical analysis suggests that an appreciation of the real exchange rate that lowers the relative price of tradable is associated with a simultaneous increase in destruction and creation that results in a net employment loss. An alternative possibility is that both the appreciation and the increase in gross flows result from a technological shift at the industry level. To see clearly the contrast between the two interpretations, consider figure 3. This paper's interpretation is that there is a stable industry relative supply curve (upper left diagram) that is mapped through exogenous shifts in the relative price λ, i.e. the real exchange rate. Associated with this stable supply curve is a stable relative factor demand curve (lower left diagram).[21] In this rendition, an appreciation is associated with a decline in λ, a decline in relative output and relative employment. An alternative interpretation (right diagrams) would assert that there is a stable de-

[21]In the context of a specific factor model for instance, assume that $Y_T = z_T L_T^{\alpha} K_T^{1-\alpha}$ and $Y_N = z_N L_N^{\alpha} K_N^{1-\alpha}$ where K_T and K_N denote sector specific capital and z_T and z_N sector specific productivities. Then clearly $\frac{Y_T}{Y_N} = \frac{z_T}{z_N}\left(\frac{L_T}{L_N}\right)^{\alpha}\left(\frac{K_T}{K_N}\right)^{1-\alpha}$. The lower panel describes this relationship for given relative productivities and relative capital.

mand curve, and that the relative supply curve shifts in response to relative technology shocks. A positive relative technology shock in tradables shifts out the relative supply curve, leading to a decline in λ (an appreciation) from λ_1 to λ_2 and an increase in relative output. In terms of net job flows, this relative technology shock may decrease relative employment in the traded sector, as illustrated in the lower right diagram.[22] While job creation may increase, job destruction may increase as well if old and unproductive production units are cleansed. In the latter case, the link between exchange rate and reallocation is spurious and simply reflects the response to sectoral relative technology shocks. Note however that relative demand shocks do not generate the same pattern, since a relative demand shock would lead to a simultaneous depreciation (an increase in λ) and a relative increase in traded goods output and tradable employment.

There are two possible lines of defense for the previous result that I now present. First, there is a subtle difference between the real exchange rate that matters in figure 3 and the one used in the regressions. Relative technology shocks will undoubtedly influence the relative price of traded and nontraded goods.[23] Instead, the previous results used a WPI-based real exchange rate. Relative technology shocks at the 4-digit level are unlikely to affect the real exchange rate constructed in this fashion. This, in effect, amounts to instrumenting the real exchange rate measure in away that

[22]Take the limit case described in Baumol, Blackman and Wolff (1985): suppose the economy produces only cars and live concerts and preferences are Leontieff. Relative technological progress in car production would lead to an overall decline in the number of workers in the car industry and an increase in the share of the labor force producing live concerts.

[23]Indeed, plots of the relative price of traded versus non traded goods constructed from the shipment deflators of the NBER Productivity Database reveal a strong and downward trend in the price of traded goods, in accordance with the faster productivity growth in those sectors.

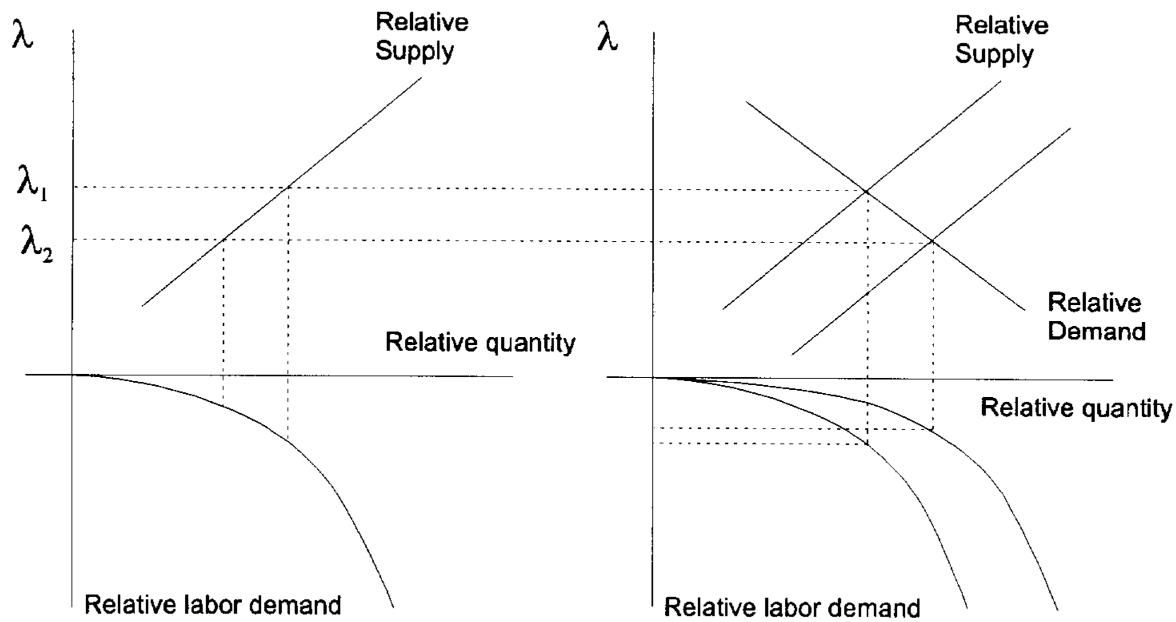

Figure 3: Relative Technology Shocks

minimizes the role of relative technology shocks. Fluctuations in the real exchange rate will thus capture mostly variations in the nominal exchange rate.

For those still unconvinced, another solution consists in explicitly instrumenting the real exchange rate λ_{it} in (1), using shifters of the relative demand schedule. Clearly, one will then only measure employment movements induced by the shifters themselves and mediated through changes in the real exchange rate, and one may miss the response to autonomous movements of the real exchange rate. To the extent that these relative demand shifts are uncorrelated with supply shifts and affect the real exchange rate however, it is still a valid exercise. As a crude attempt, I report estimates using the Hall-Ramey set of instruments(see Hall (1988)): the growth rate of military expenditures, the growth rate of the crude oil price and the political party of the President.[24]

[24]The set of instruments is common to all sectors. Yet the coefficients from the first stage are

Military expenditures is likely to be the best instrument for our purpose since military expenditures tend to be fairly concentrated in a few manufacturing industries.

Panel B in Tables 3-5 present 2SLS estimates. Comparing the results with the simple fixed effect estimates, it is immediate that employment growth becomes non-significant for all groups. Looking at gross flows, job creation appears to respond more strongly to exchange rates. A 10% depreciation leads to a decline of 0.40% in job creation in traded industries. Overall, the results indicate that there is a strong response of gross flows, less so for net flows. The absence of a net effect may also suggest that the grouping remains too coarse for an analysis of exchange rate movements.

3.2.2. Dynamic analysis. The preceding results describe an economy that reacts on average and with some lags to exchange rate movements. This section takes a more rigorous approach towards controlling for possible endogeneity of the exchange rate by using sectoral VARs, along the lines of Davis and Haltiwanger (1997).

I estimate a VAR for each 4-digit industry classified as traded or non-traded. The VAR for sector j contains an aggregate bloc with the Hamilton oil price index s_t, total manufacturing job creation and destruction for all sectors but sector j, denoted JC_t^{-j} and JD_t^{-j}, and the quality spread between 6 months commercial paper and 6 months T-Bill, m_t.[25] This definition of aggregate flows ensures that idiosyncratic shocks to sectoral flows will not influence aggregate flows for large sectors. The VAR

industry dependent. A better solution, not investigated in this paper, would use sector specific demand shifters, along the lines of Shea (1993)

[25]The Hamilton's net oil price measure is the maximum of 0 and the difference between the log level of the crude oil price for the current month and the maximum value of the logged crude oil price over the previous 12 months. The spread captures monetary policy. Unreported results using the Federal Funds rate as the instrument of monetary policy yield essentially unchanged results.

also includes the sectoral real exchange rate λ_{st} as well as sectoral job creation and destruction JC_{st} and JD_{st}. I make the following assumptions:

1. the sectoral gross flows do not affect either aggregate variables or the sectoral real exchange rate;
2. aggregate variables are bloc Wold causally ordered and prior to the sectoral ones;
3. the real exchange rate is Wold causally ordered after the aggregate variables and before the sectoral flows;
4. the covariance matrix of structural innovations is bloc diagonal

Note that under these assumptions the real exchange rate is only restricted not to influence aggregate variables within the quarter. Given the possible feedback from the real exchange rate, the assumption that sectoral flows are independent from the real exchange rate only ensures that they do not indirectly affect aggregate variables.[26]

Formally, denoting Z_t for the first 4 aggregate variables of the 7-variable vector (in that order), and S_t for the sectoral job creation and destruction rates, the VAR system is written:

$$Z_t = \sum_{i=1}^{p}(\psi_{zz,i}Z_{t-i} + \psi_{z\lambda,i}\lambda_{st-i}) + B_{zz}\epsilon_{z,t}$$

[26]Given these assumptions, and unlike Davis and Haltiwanger (1997), the set of aggregate innovations is sector dependent. In practice, the results are virtually unchanged if we assume instead that the real exchange rate does not influence aggregate variables at all lags. In addition, Davis and Haltiwanger (1997) decompose oil price movements into positive and negative components. It is comforting, however, to find that oil shocks play a similar role in this decomposition and theirs.

$$\lambda_{st} = \sum_{i=1}^{p} \left(\psi_{\lambda z,i} Z_{t-i} + \psi_{\lambda\lambda,i} \lambda_{st-i} \right) + B_{\lambda z} \epsilon_{z,t} + \epsilon_{\lambda,t}$$

$$S_{st} = \sum_{i=1}^{p} \left(\psi_{sz,i} Z_{t-i} + \psi_{s\lambda,i} \lambda_{st-i} + \psi_{ss,i} S_{st-i} \right) + B_{sz} \epsilon_{z,t} + B_{s\lambda} \epsilon_{\lambda,t} + B_{ss} \epsilon_{s,t}$$

where p is the order of the VAR , ψ_{ij} and B_{ij} are matrices of the appropriate dimensions, and ϵ_t is a vector of structural innovations.[27]

Under the assumption of bloc recursivity, it is possible to evaluate the contribution of each bloc to the variance of forecast errors. The variance decomposition of the forecast errors is important to evaluate the importance of exchange rate shocks at the sectoral level. Tables 6-7 report the employment weighted average variance decomposition at 1, 4, and 8 quarters for industry job creation and destruction rates as well as the exchange rate.[28]

First one observes that exchange rate innovations represent a substantial fraction of the forecast error variance of the exchange rate itself, further substantiating the assumption that exchange rates contain an important autonomous component. Around 65% of the eight-step ahead forecast error variance is attributed to the exchange rate innovation. By contrast, monetary innovations only represent 9 to 14%. The tables also indicate that exchange rate movements contribute a nonnegligible amount to the overall gross flows fluctuations, around 3% during the first quarter, and increases as the horizon lengthens, reaching 8 to 12% after 8 quarters. The standard errors indicate

[27]In practive, given the relatively small sample, I take $p = 4$. Given assumption (2), the matrix B_{zz} is lower bloc triangular with 1 on the diagonal.

[28]The standard errors are obtained by two-stage bootstrapping. Bias corrected estimate are obtained after 500 iterations. Standard errors are obtained after 100 additional iterations. For each iteration, the entire matrix of residuals for all sectors simultaneously is sampled with replacement in order to preserve the cross sectional correlation.

Table 6: VARIANCE DECOMPOSITION I

NON TRADED

Shock:	Oil		Aggregate		Spread		Exch. Rate		Sectoral	
Qtr.	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE
Job Creation										
1	4.02	1.98	13.46	2.88	2.38	1.43	3.42	1.07	76.73	3.60
4	6.84	1.90	18.31	2.66	7.31	1.63	6.93	0.96	60.85	2.77
8	9.42	1.87	20.33	2.49	8.27	1.64	8.14	1.04	53.84	2.41
Job Destruction										
1	5.04	2.07	13.25	3.77	4.87	1.92	2.40	0.79	74.44	3.57
4	8.56	1.65	18.21	2.73	8.78	2.08	6.19	1.11	58.26	2.78
8	13.01	1.64	19.70	2.51	10.74	2.13	7.33	1.10	49.21	2.53
Exchange Rate										
1	2.40	1.85	7.48	3.62	3.56	2.29	86.56	4.57		
4	3.27	2.61	11.54	4.31	5.79	3.09	79.40	4.87		
8	7.39	3.67	14.06	4.48	9.17	3.93	69.38	5.26		

TRADED

Job Creation										
1	2.61	1.58	9.93	2.38	2.64	1.25	3.70	1.20	81.13	2.61
4	8.57	2.08	17.45	2.43	7.35	1.61	8.02	1.11	58.61	1.92
8	11.57	2.14	21.12	2.23	9.16	1.64	9.81	1.01	48.34	1.70
Job Destruction										
1	3.83	1.70	11.37	2.19	2.89	1.26	2.94	1.17	78.97	2.73
4	11.33	2.21	14.56	2.25	10.54	1.58	9.76	0.95	53.80	2.53
8	15.83	2.51	17.38	2.13	13.07	1.91	11.01	0.84	42.72	2.12
Exchange Rate										
1	3.13	2.45	10.16	2.37	4.08	1.61	82.63	3.31		
4	3.93	2.22	13.06	3.37	7.89	2.34	75.13	3.97		
8	5.54	2.81	13.47	4.68	14.27	2.92	66.71	4.53		

Note: The table reports the average variance decomposition for a sectoral 7 variable VAR including Hamilton's oil price index, total manufacturing job creation and destruction, a 6 months quality spread, the industry specific real exchange rate and industry job creation and destruction. Source: gross flows: LRD; Spread, Oil price and real exchange rate: IFS and author's calculations

Table 7: VARIANCE DECOMPOSITION II

EXPORTERS

Shock	Oil		Aggregate		Spread		Exch. Rate		Sectoral	
	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE
Job Creation										
1	3.35	2.00	9.87	2.86	3.10	1.73	4.34	1.55	79.33	3.15
4	7.54	2.42	18.59	2.70	6.32	2.26	8.44	1.47	59.10	2.13
8	11.66	2.46	23.93	2.50	7.68	2.21	10.07	1.39	46.66	2.01
Job Destruction										
1	4.76	2.12	11.85	2.64	2.83	1.37	2.91	1.43	77.65	3.18
4	9.90	2.06	14.98	2.46	11.69	1.91	12.30	1.38	51.13	2.54
8	14.86	2.64	17.44	2.43	14.78	2.41	12.75	1.24	40.18	2.17
Exchange Rate										
1	3.72	2.30	11.27	3.08	3.95	2.01	81.06	3.88		
4	3.97	2.41	14.07	4.05	7.47	2.61	74.48	4.75		
8	5.46	3.14	14.37	5.72	14.36	3.41	65.81	5.41		

IMPORT-COMPETING

Shock	Oil		Aggregate		Spread		Exch. Rate		Sectoral	
Job Creation										
1	1.72	2.78	9.93	4.05	2.11	1.73	3.04	1.86	83.20	4.25
4	9.81	3.10	15.75	3.53	8.76	1.80	7.67	1.55	58.01	3.03
8	11.37	3.00	17.19	3.35	11.13	1.86	9.55	1.34	50.76	2.68
Job Destruction										
1	2.46	2.27	10.73	3.34	2.88	2.80	3.02	1.98	80.90	4.80
4	13.08	3.45	13.92	3.54	8.78	2.37	6.47	1.48	57.74	3.81
8	16.93	3.22	17.13	3.14	10.54	2.28	8.76	1.25	46.65	3.21
Exchange Rate										
1	2.37	4.33	8.61	2.64	4.27	2.28	84.75	4.87		
4	3.81	3.23	11.48	4.25	8.66	2.94	76.06	4.76		
8	5.60	3.48	12.04	5.34	14.55	3.07	67.82	5.25		

Note: The table reports the average variance decomposition for a sectoral 7 variable VAR including Hamilton's oil price index, total manufacturing job creation and destruction, a 6 months quality spread, the industry specific real exchange rate and industry job creation and destruction. Source: gross flows: LRD; Spread, Oil price and real exchange rate: IFS and author's calculations that this share is significant. Most of the fluctuations remain explained by sectoral shocks and aggregate fluctuations contributed by the innovations to aggregate job creation and destruction.

These results indicate that autonomous exchange rate fluctuations are a significant force behind industry evolutions. Somewhat more surprisingly, the results also indicate that non-traded industries seem only slightly less sensitive to exchange rate movements.

Turning to the dynamic response of gross and net flows, Figure 4 reports normalized cumulated average impulse response of job creation, job destruction and, implicitly, net employment growth to the spread shocks, supply shocks and real exchange rate shocks (columns) for the traded, non traded, exporters and import-competing sector (rows). Complete identification is obtained by imposing a Cholesky ordering.[29] Starting with the second column, one observes that a unit standard deviation in the spread variable has a substantial and long lasting effect on net and gross employment. Employment declines, as a result of a mild decline in job creation and a sharp increase in job destruction in all sectors. Employment growth bottoms out after 8 to 10 quarters. These impulse responses resemble what we know about the effect of monetary policy shocks on job creation and destruction (see Davis et al. (1996)).

Turning to the response to real exchange rate shocks, observe first that the amplitude is smaller. An unexpected depreciation of the real exchange rate increases employment growth in all traded industries. About 4 quarters following a positive 1 standard deviation real exchange rate shock employment growth is 1.40% higher for export sectors and roughly 0.75% higher in import-competing sectors. Job destruction

[29]Since I do not look into the dynamic response to aggregate and sectoral job creation and destruction, the results are robust to the identification procedure.

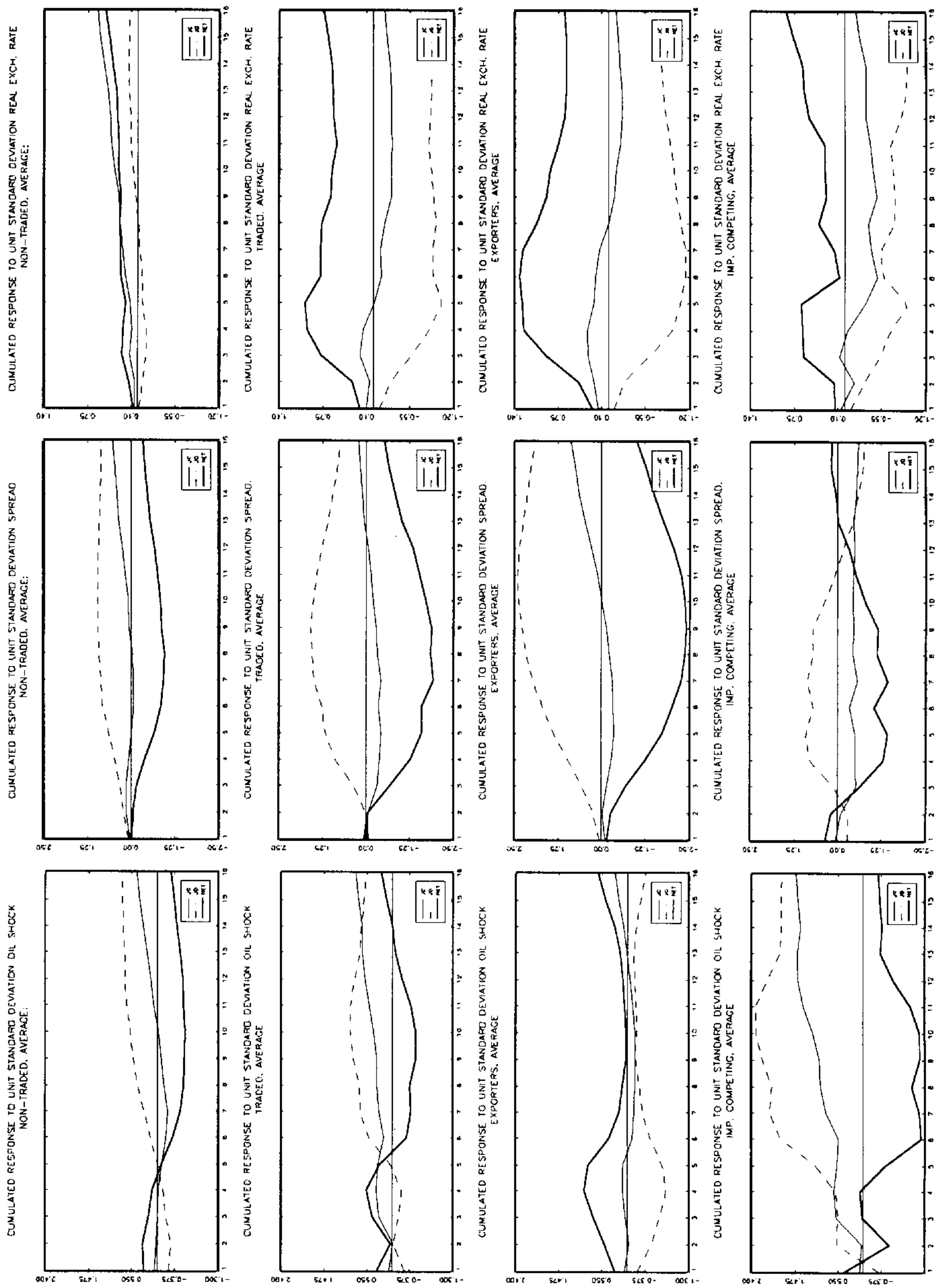

Figure 4: Average normalized cumulated response functions to oil, monetary and real exchange rate shocks.

declines significantly in both sectors by roughly similar amounts. However, the results indicate very different dynamics of job creation in the export and import-competing sectors. While job creation is mildly positive in the export sector following a depreciation and turns negative after 8 quarters, job creation falls significantly after only 4 quarters in import competing industries. The contrast between a monetary shock and an exchange rate shock is most striking for import competing firms: while job creation and job destruction move in opposite direction in response to a spread shock, they appear to comove positively in response to exchange rate innovations. This result is further confirmed by looking at the response to oil price shocks (first column) for that sector: job creation increases by 1.5% and job destruction by 2.4% following a normalized increase in oil prices.

Table 8 reports the cumulative 8 and 16 steps impulse response to the oil, spread and exchange rate shocks.

First note that job destruction is more volatile than job creation in response to almost all shocks considered. Furthermore, the response to 'reallocation' shocks (real exchange rate and oil shock) differ markedly from the response to monetary shocks for import-competing sectors, and less so for export sectors. An appreciation triggers a wave of job separations (0.64% for a normalized appreciation after 8 quarters), but also an associated increase in job creation (0.48%). By contrast, a tightening of monetary policy increases job destruction by 0.80% and decreases job creation by 0.55%. Export industries, exhibit a more traditional pattern, in response to an appreciation, with a slight decline in job creation (0.16%) and a substantial increase in job destruction (1.47%).

To shed some additional light on this result, the table further presents the cumulated impulse response for Motor Vehicles (SIC 3711) and Aircraft (SIC 3721). Each

Table 8: CUMULATIVE IMPULSE RESPONSE

	8-QUARTERS											
	Job Creation						Job Destruction					
	Oil		Spread		Exchange		Oil		Spread		Exchange	
Sector	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE
Non-Traded	-0.22	0.10	-0.05	0.07	0.24	0.06	0.29	0.13	0.88	0.11	-0.05	0.07
Traded	0.31	0.19	-0.43	0.16	-0.13	0.12	0.70	0.35	1.54	0.22	-1.12	0.18
Exporters	-0.15	0.16	-0.33	0.15	0.16	0.09	-0.29	0.25	2.09	0.21	-1.47	0.11
Import-Competing	0.89	0.33	-0.55	0.26	-0.48	0.22	1.97	0.65	0.80	0.65	-0.64	0.35
Motor Vehicles, 3711	3.29	1.32	-1.50	0.40	-1.37	0.52	5.43	1.45	0.08	1.25	-2.28	0.65
Aircraft, 3721	-0.42	0.17	-0.65	0.18	0.33	0.23	0.07	0.21	2.20	0.23	-0.49	0.21
	16-QUARTERS											
	Oil		Spread		Exchange		Oil		Spread		Exchange	
Sector	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE
Non-Traded	0.48	0.12	0.57	0.13	0.59	0.11	0.72	0.15	0.90	0.16	0.14	0.14
Traded	0.79	0.37	0.31	0.28	-0.21	0.22	0.62	0.51	0.74	0.43	-1.12	0.26
Exporters	0.25	0.21	0.95	0.20	-0.19	0.15	-0.22	0.26	1.83	0.26	-0.99	0.16
Import-Competing	1.47	0.76	-0.51	0.55	-0.18	0.45	1.71	1.03	-0.68	0.85	-1.25	0.52
Motor Vehicles, 3711	3.49	1.45	-3.04	0.55	-1.21	0.58	4.32	1.65	-4.86	1.65	-1.58	0.74
Aircraft, 3721	-0.04	0.45	0.02	0.53	-0.78	0.42	-0.06	0.36	2.33	0.45	-1.00	0.40

Note: The table reports the average 8 and 16 steps cumulative impulse response of sectoral job creation and destruction to an oil price shock, a monetary policy shock and a real exchange rate shock. Source: gross flows: LRD; Spread, Oil price and real exchange rate: IFS and author's calculations

sector represents the largest sector of the import-competing and export industries respectively with an employment share of 30.87% and 12.60% (see Table 13). Both sectors largely reproduce the average results, with, in particular, a substantial positive comovement of job creation and destruction in the Automobile industry. While it is beyond the scope of this paper to analyze sectoral dynamics in detail, it is worth noting that this specific pattern could result from the establishment of Japanese-owned car factories in the US in the eighties, following the appreciation of the US currency. However, there is more to the results than simply the Automobile industry. 21 out of the 39 import-competing industries –representing 72% of import-competing employment–

exhibit a pattern similar to the average.[30] By contrast, 12 out of the 34 export industries –representing only 36% of employment– exhibit positive comovement between job creation and destruction after 8 quarters.

The positive sectoral comovement is also obtained by Davis and Haltiwanger (1997) in their study of the effect of oil shocks. While these authors do not emphasize this point, they interpret the positive comovement as an indication of the reallocative nature of oil shocks, within narrowly defined industries. The results presented in Table 8 confirm their analysis and extends it also point real exchange rate fluctuations.

I now summarize the paper's main findings so far:

- There are substantial variations in openness and international exposure within the US manufacturing sector. Using a classification based on export shares and import penetration ratio, it appears that tradable firms are more productive, more capital intensive and pay higher wages. Further, within tradables, import-competing firms are less productive, less capital intensive and employ fewer workers;

- Looking at the SIC composition of the traded and nontraded groups, nontradable are concentrated in nondurables (Food and Printing) as well as heavy durables for which transportation costs are presumably prohibitive (concrete, bricks). Import-competing industries represent a relatively small share of the overall manufacturing employment and tend to be concentrated in Paper, Leather and Motor Vehicles);

- Exchange rate fluctuations do affect tradable industries. According to the paper's benchmark estimates, a 10% depreciation of the real exchange rate boosts

[30]If one excludes Automobile industry, the number remains 60% of employment.

employment by 0.27%, combining a decline in job destruction of 0.44% and a decline of job creation of 0.17%;

- Job destruction appears more volatile than job creation, confirming a now well-established stylized fact for the US manufacturing as a whole;

- Although the impact of real exchange rates is significant, they constitute a relatively minor source of gross and net employment fluctuations, accounting for roughly 10% of the forecast error in sectoral gross flows;

- More strikingly, job creation and job destruction appear to comove positively in response to reallocation shocks, especially in import-competing industries. A similar result is obtained, although not emphasized, by Davis and Haltiwanger (1997) in the context of oil shocks;

- Thus, for the typical tradable industry, appreciation episodes are times of turbulence, while depreciations are times of 'chill', with a lower job creation and destruction.

Previous empirical studies have documented extensively the negative comovements in job creation and destruction following aggregate perturbations. The new finding here is that reallocative disturbances can induce sizeable positive comovements of sectoral flows. The next section aims at exploring the extent to which a existing models of reallocation can account for both set of facts simultaneously. While the positive sectoral comovements are reminiscent of a 'cleansing' type mechanism, I will argue that the cleansing effect will generically be stronger in response to aggregate shocks than to sectoral ones, in direct contradiction with the evidence so far.

4. MODELS OF REALLOCATION AND SECTORAL CORRELATIONS

To gain intuition for the previous statement, and in preview of the formal model, suppose that an economy can produce two goods, tradables and nontradables. Production units in this economy are buffeted by three types of shocks: aggregate, reallocation and idiosyncratic shocks. The reallocation shock takes the form of a shock to the relative price of tradable in terms of nontradables –one possible definition of the real exchange rate–, but this is not essential for our results. Assume also, somewhat not too unrealistically, that it takes time to match workers and jobs. To make things even simpler, assume that the economy is efficient so that the competitive equilibrium coincides with the solution to the central planner's problem.[31] With such environment as our background I now turn to the equilibrium sectoral dynamics and the timing of entry and exit. Suppose, to start with, that the economy is hit by a negative aggregate productivity shock. By definition, all units, irrespective of their specialization, are worse off. The value of production declines in both sectors, compared to non-market activities, such as search. This makes it a good time to cleanse the productive structure by releasing labor for more productive matches. This is the essence of the 'cleansing' approach of recessions (Cooper et al. (1994), Cohen and Saint-Paul (1992)). Since the planner would want to minimize the amount of time the average worker spend unemployed in the efficient equilibrium, job creation will increase strongly on the tails of job destruction. Unemployment will be short-lived and gross flows will tend to be positively correlated. Now let's look at the same dynamics through competitive lenses. The increase in creation occurs through a decline in the opportunity cost of employment.

[31] In search models such as the one presented shortly, the decentralized equilibrium is efficient when the congestion and search externalities balance out exactly (Hosios (1990)).

As destruction picks up and unemployment rises in both sectors, workers become less picky about their employment opportunities, thus inducing the subsequent surge in creation.

Consider now the response to a decline in the relative price of tradables. The planner will want to reallocate workers from the tradable sector to the nontradable. The value of tradable good production declines relative to both non-market activities and nontradable production. As before, labor is released in the tradable sector, and as before the planner will want to minimize the amount of time that the worker spends idle. This is easier this time around since nontradables is experiencing a boom. In other words, the efficient response is an intersectoral reallocation. In particular, there is no need to increase creation in the tradable sector. The very nature of a reallocation shock is such that one sector of the economy can pick up the slack. In the decentralized equilibrium, we will observe that the opportunity cost of employment remains mostly unchanged. What does this all imply for the correlation of sectoral gross flows? Although aggregate gross creation and destruction may still be positively correlated, the correlation of sectoral flows will *have* to be smaller.

While the preceding intuition assumed that the economy was efficient, the decentralized equilibrium will carry over the same features. What is essential here is that other sectors of the economy can assume the slack following reallocation shocks, and preventing the opportunity cost of employment from adjusting downward.

4.1. The model.

4.1.1. Consumers. I make the following assumptions. Time is discrete. The domestic economy consists of two sectors: tradables and nontradables. The demand side of the economy is characterized by a representative agent with risk neutral preferences over both goods:

$$U_0 = E_0 \left[\sum_{t=0}^{\infty} \beta^t C_t \right] \tag{2}$$

where β is the discount factor and C_t is a constant elasticity of substitution consumption index defined as:

$$C_t = \left[\gamma^{\frac{1}{\phi}} \left(x_t^d \right)^{\frac{\phi-1}{\phi}} + (1-\gamma)^{\frac{1}{\phi}} y_t^{\frac{\phi-1}{\phi}} \right]; \quad \phi > 0,\, 0 < \gamma < 1 \tag{3}$$

where ϕ is the elasticity of substitution between tradable x_t^d and nontradables y_t. These preferences yield standard iso-elastic demand for each good. Normalizing the price of nontraded goods to 1, and denoting p_t the price of traded goods, I define the price of the consumption index C_t, defined as $q_t = \left[1 - \gamma \left(1 - p_t^{1-\phi} \right) \right]^{\frac{1}{1-\phi}}$.

p_t is exogenous and fluctuates stochastically. An *increase* in p_t represents an increase in the relative price of tradables, that is, a depreciation of the real exchange rate.[32] I assume that p_t follows a discrete Markov process with n_p states and transition matrix Q_p where $Q_p(j,i) = \Pr\left(p_{t+1} = p_i | \, p_t = p_j\right)$. Both goods are nonstorable, but agents can borrow and lend tradable goods internationally at a gross interest rate R_t. With an outstanding stock of international debt B_t (in tradables), the budget constraint is:

$$p_{t+1} B_{t+1} = \frac{q_{t+1}}{\beta q_t} \left(p_t B_t + H_t - q_t C_t \right)$$

where, given the assumption of risk neutrality, $\frac{q_{t+1}}{\beta q_t}$ is the inverse of the pricing kernel for tomorrows nontradables. H_t denotes total current income (labor and dividends)

[32] A change in p_t forces a reallocation of resources between the traded and non-traded sectors. Therefore, in what follows, I refer to p_t indifferently as the relative price or reallocation shock.

received by the representative agent.

4.1.2. Technology and Matching. The elementary unit of production is the combination of a worker and a technology, so that one should think of firms and plants as representing many simultaneous production units.[33] I assume that the technology is Leontieff with one worker producing $A^x(z+\epsilon_i)$ units of traded good or $A^y(z+\epsilon_i)$ units of nontraded goods where z represents an aggregate productivity shock that affects units in both sectors identically and ϵ_i is an idiosyncratic shock. A^j represents the average labor productivity in sector j. Aggregate shocks follow a discrete Markov process with n_z states, a transition matrix Q_z and an unconditional mean of 1.

The state variables for this economy consist of the aggregate and the relative price shocks as well as the cross sectional distribution of firm specific productivities in both sectors. As is common in this type of models, I will concentrate on an equilibrium where all aggregate variables except employment do not depend on the cross section distribution. Define $s=(z,p)$, then s follows a Markov process with transition matrix Q derived from Q_p and Q_z. The total number of states is $n_s=n_zn_p$.

As in Mortensen and Pissarides (1994), I assume that idiosyncratic shocks follow a Poisson process with arrival rate λ. The new value of ϵ is drawn from a fixed distribution $G(\epsilon)$ with support $[\epsilon_l,\epsilon_u]$.[34]

Denoting v_t^x and v_t^y the number of vacancies posted in the tradable and nontradable sectors respectively, the number of matches formed in each sector is equal to $m(u_t,v_t^x)$ and $m(u_t,v_t^y)$ where m is a constant returns to scale matching function.[35] There is no

[33]Clearly, this abstracts from any vertical aspects of the production process: a firm is the horizontal combination of many identical production units except for the realization of their idiosyncratic shock.

[34]Under this assumption, new idiosyncratic shocks are independent from old ones, yet the process exhibits persistence.

[35]Under that specification, one extra vacancy posted in one sector does not affect the worker's

on-the-job search and workers need to be unemployed first before finding a new job. I define the job matching probability as $\pi_t = \frac{m_t}{v_t}$ and the worker matching probability as $\mu_t = \frac{m_t}{u_t}$. Under the CRS assumption, one can characterize the job finding rates in each sector, π_t^j, as a function of that sector's labor market tightness $\theta_t^j = \frac{v_t^j}{u_t}$: $\pi_t^j = \pi\left(\theta_t^j\right) = m\left(\frac{1}{\theta_t^j}, 1\right)$. Similarly, $\mu_t^j = m\left(1, \theta_t^j\right) = \theta_t^j \pi\left(\theta_t^j\right)$. The overall probability of finding a job at time t is $\mu_t^x + \mu_t^y$. Under this specification, workers cannot arbitrage between traded and nontraded sector jobs.[36] I assume the following obvious properties: : $\lim_{\theta \to 0} \pi(\theta) = 1$, $\lim_{\theta \to 0} \theta\pi(\theta) = 0$, and $0 \leq \eta(\theta) = -\frac{\theta\pi'(\theta)}{\pi(\theta)} \leq 1$. The last property ensures that $\pi'(\theta) \leq 0$ and $(\theta\pi(\theta))' \geq 0$, so that an increase in labor market tightness decreases the worker's arrival rates and increases the jobs arrival rates. Prospective employers post vacancies at a cost ν per period, in units of the good produced in that sector.[37] Lastly, newly formed matches are the most productive with $\epsilon = \epsilon_u$ and firms enter the traded sector as long as profits are positive.[38]

4.1.3. Market clearing. Denote $E_t^j(\epsilon)$ the cross section of employment in sector j at time t. The following market clearing conditions hold:

$$E_t^x = \int E_t^x(\epsilon)\, d\epsilon \tag{4}$$

$$E_t^y = \int E_t^y(\epsilon)\, d\epsilon \tag{5}$$

$$u_t = 1 - E_t^y - E_t^x \tag{6}$$

arrival rate in the other sector.

[36]See Moen (1997) for a model where workers can decide which pool they apply to.

[37]The vacancy cost can be thought of as foregone output.

[38]The assumption that all firms enter 'at the top' is common in the literature. It is not crucial in our context but it simplifies employment dynamics since all entrants are identical. It captures the idea that production units become -stochastically- obsolete over time.

$$y_t + \nu\, u_t \mu_t^y = \int A^y (z_t + \epsilon)\; E_t^y (\epsilon)\; d\epsilon \tag{7}$$

$$x_t + \nu\, u_t \mu_t^x = \int A^x (z_t + \epsilon)\; E_t^x (\epsilon)\; d\epsilon \tag{8}$$

The first two equation express sectoral employment from the cross-section in each sector. With a labor force normalized to 1, equation (6) is the labor market equilibrium. Lastly, equation (7)-(8) express the market clearing conditions for tradables and non-tradables. The term $\nu\, u_t \mu_t^j$ represents the search and hiring costs incurred at time t in sector j. Finally, under the free entry condition, and assuming that workers pool income and financial resources, there is no distributed dividend and total income is simply:

$$H_t = \int w_t^x (\epsilon)\, E_t^x (\epsilon) + w_t^y (\epsilon)\, E_t^y (\epsilon)\; d\epsilon = p_t x_t + y_t$$

Plugging that into the representative agent's budget constraint, one obtains:

$$p_{t+1} B_{t+1} = \frac{q_{t+1}}{\beta q_t} \left(p_t B_t + p_t \left(x_t - x_t^d \right) \right) \tag{9}$$

the last term in parenthesis $p_t \left(x_t - x_t^d \right)$ is the trade balance at time t, expressed in non-tradables units.

4.2. The competitive equilibrium. To characterize the competitive equilibrium, I now derive standard asset equations for a representative firm. Consider a production unit in sector j matched with a worker and facing an idiosyncratic shock ϵ in state s at the beginning of the period. Should employment be continued, the value of the match to the firm, $\tilde{J}_s^j (\epsilon)$ is equal to:

$$\begin{aligned}\tilde{J}_s^j(\epsilon) &= p_s^j A^j(z_s+\epsilon) - w_s^j(\epsilon) \\ &\quad + \beta \sum_{s'} Q_{ss'} \frac{q_s}{q_{s'}} \left[(1-\lambda) J_{s'}^j(\epsilon) + \lambda \int J_{s'}^j(\epsilon') \, dG(\epsilon') \right]\end{aligned} \tag{10}$$

The first two terms on the right hand side represent the flow profits to the firm $p_s^j A^j(z_s+\epsilon) - w_s^j(\epsilon)$ in the current period, where $p^y = 1$ and $p^x = p$. The remaining terms represent the option value associated with maintaining the production unit active. I describe each term in turn. First, the aggregate state may change from s to s' with probability $Q_{ss'}$. Second, the unit gets a new draw of its idiosyncratic productivity ϵ' with probability λ or keep its current productivity level ϵ. In either case the firm will get an optimal value $J_{s'}^j$. Lastly, the value of the firm tomorrow, in terms of nontradables, is discounted using the state-contingent pricing kernel $\beta \frac{q_s}{q_{s'}}$.

The value to the firm of the match today is then:

$$J_s^j(\epsilon) = \max \left\langle \tilde{J}_s^j(\epsilon), V_s^j \right\rangle$$

The value of a vacancy V_s^j, can be determined similarly:

$$V_s^j = \max \left\langle -\nu p_s^j + \beta \sum_{s'} Q_{ss'} \frac{q_s}{q_{s'}} \left[\pi_s^j J_{s'}^j(\epsilon_u) + \left(1-\pi_s^j\right) V_{s'}^j \right], 0 \right\rangle \tag{11}$$

Posting a vacancy in sector j costs νp_s^j. With probability π_s^j the vacancy is filled and the unit starts producing next period in state s' with an idiosyncratic shock ϵ_u. Otherwise the vacancy remains unfilled with value $V_{s'}^j$. Since it is costless to stop posting the vacancy, the firm will only post if $V_s^j > 0$.

Under the assumption of free entry, the value of a vacancy must be zero in either sector: $V_s^j = 0$ for all states s. Substituting into (11):

$$\frac{\nu p_s^j}{\pi_s^j} = \beta \sum_{s'} Q_{ss'} \frac{q_s}{q_{s'}} J_{s'}^j (\epsilon_u) \tag{12}$$

This is the *entry condition.* It states that the expected cost of a vacancy is equal to the expected profit from the new match.[39]

Turning to the workers, denote $W_s^j(\epsilon)$ the value of holding a job in sector j when the aggregate state is s and the idiosyncratic shock is ϵ. The continuation value inside the match, $\tilde{W}_s^j(\epsilon)$,is determined as:

$$\tilde{W}_s^j(\epsilon) = w_s^j(\epsilon) + \beta \sum_{s'} Q_{ss'} \frac{q_s}{q_{s'}} \left[(1-\lambda) W_{s'}^j(\epsilon) + \lambda \int W_{s'}^j(\epsilon') \, dG(\epsilon') \right] \tag{13}$$

The worker gets a wage $w_s^j(\epsilon)$. Next period with probability λ a new idiosyncratic shock is drawn from the distribution G. The worker ends the relationship as soon as $\tilde{W}_s^j(\epsilon)$ falls below the value of being unemployed U_s :

$$W_s^j(\epsilon) = \max \left\langle \tilde{W}_s^j(\epsilon), U_s \right\rangle$$

Lastly, an unemployed worker finds a job opportunity in the traded (resp. nontraded) sector with probability μ_s^x (resp. μ_s^y). The value of being unemployed is therefore:

$$U_s = \beta \sum_{s'} Q_{ss'} \frac{q_s}{q_{s'}} \left[(1 - \mu_s^x - \mu_s^y) U_{s'} + \mu_s^x W_{s'}^x(\epsilon_u) + \mu_s^y W_{s'}^y(\epsilon_u) \right] \tag{14}$$

Since the production unit must incur search costs before it can hire a new worker, there are quasi rents associated with the match. I assume that the surplus is divided

[39]Note that $\frac{1}{\pi}$ is the expected duration until the a match is found.

according to the Nash bargaining rule with a share δ accruing to the worker and a share $(1-\delta)$ to the firm. This implies that all separations are *ex-post* efficient as workers and firms maximize the joint surplus generated by the match, $S_s^j(\epsilon)$:

$$S_s^j(\epsilon) = J_s^j(\epsilon) + W_s^j(\epsilon) - U_s$$

Using the Nash bargaining rule, and rewriting the asset equation for both the worker and the firm, one obtains:

$$\begin{aligned} \tilde{S}_s^j(\epsilon) &= p_s^j A^j(z_s+\epsilon) + \beta \sum_{s'} Q_{ss'} \frac{q_s}{q_{s'}} \left[(1-\lambda) S_{s'}^j(\epsilon) + \lambda \int S_{s'}^j(\epsilon') dG(\epsilon') \right. \\ & \quad \left. -\delta\left(\mu_s^x S_{s'}^x(\epsilon_u) + \mu_s^y S_{s'}^y(\epsilon_u)\right)\right] \\ S_s^j(\epsilon) &= \max\left\langle \tilde{S}_s^j(\epsilon), 0\right\rangle \end{aligned} \tag{15}$$

Lastly, one can rewrite the free entry conditions as:

$$\pi_s^j = \frac{\nu p_s^j}{\beta(1-\delta)\sum_{s'} Q_{ss'} \frac{q_s}{q_{s'}} S_{s'}^j(\epsilon_u)} \tag{16}$$

Defining $\bar{S}$ as the collection of surplus functionals $S_1^x, ..., S_{N_s}^x$, $S_1^y, ..., S_{N_s}^y$, (16) can be implicitly inverted to obtain the job arrival rates μ_s^x, μ_s^y as a function of the surplus functions $\bar{S}$. One can then construct the operator $T\left(\bar{S}\right)$, according to the right hand side of (15) and (16). An equilibrium is defined as a fixed point of the T operator. Clearly, the proposed equilibrium does not depend on the cross section distribution of idiosyncratic productivities, as was claimed initially.

With a production function that is linear in ϵ, it is easy to show that the equilibrium surplus functions are piecewise linear, increasing in ϵ, and satisfy the cut-off property.

One can then characterize the solution in terms of a vector of cut-off for each sector, $\{\epsilon_s^x, \epsilon_s^y\}_{s=1}^{n_s}$ such that $S_s^j(\epsilon_s^j) = 0$.

The following proposition fully characterizes the competitive equilibrium:

Proposition 1. *The surplus functions* $\{S_s^x, S_s^y\}_{s=1}^{n_s}$ *satisfy the cut-off property and are piecewise linear. Moreover, the cut-off for each sector* $\{\epsilon_s^x, \epsilon_s^y\}_{s=1}^{n_s}$ *fully determine the surplus functions. Lastly, the cut-off solve:*

$$\begin{aligned} p^j A^j\left(z_s + \epsilon_s^j\right) &= \beta\delta \sum_{s'} Q_{ss'} \frac{q_s}{q_{s'}} \left(\mu_s^x S_{s'}^x(\epsilon_u) + \mu_s^y S_{s'}^y(\epsilon_u)\right) \\ &\quad -\beta \sum_{\epsilon_s^j > \epsilon_{s'}^j} Q_{ss'} \frac{q_s}{q_{s'}} (1-\lambda) S_{s'}^j\left(\epsilon_s^j\right) \\ &\quad -\beta \sum_{s'} Q_{ss'} \frac{q_s}{q_{s'}} \lambda \int_{\epsilon_{s'}^j}^{\epsilon_u} S_{s'}^j(\epsilon')\, dG(\epsilon') \end{aligned} \tag{17}$$

where the job arrival rates μ_s^j *are determined by (16).*

The cut-off equations (17) characterize the *exit condition*. The left hand side of equations (17) represents the lowest acceptable flow sales from the match in state s. The first term on the right hand side represents the opportunity cost of employment, that is, the expected gain from search: with probability $\mu_s^j Q_{ss'}$ the unemployed worker finds a job in sector j in aggregate state s'. The worker then gets a fraction δ of the surplus $S_{s'}^j$. The term on the second line represents the option value associated with the realization of an aggregate or reallocation shock that lowers the cut-off ϵ^j and therefore increases the value of the existing match while the idiosyncratic component remains unchanged. Finally the last term represents the option value associated with the realization of a new idiosyncratic shock ϵ' together with a change in the state variable to s'. As in Mortensen and Pissarides (1994), the lowest acceptable flow profit is lower than the opportunity cost, as both the worker and the firm are willing to incur a loss today in anticipation of a future improvement in the value of the match.

This proposition reduces enormously the dimensionality of the problem. Instead of solving for a fixed point of the mapping T, we are looking for a set of $2n_s$ cut-off that solve the non-linear system (17).

Let's gather a few remarks about the equilibrium. First note that the model does not force an identical response in both sectors to aggregate shocks. If average tradables labor productivity pA^x (in terms of nontradables) exceeds nontradables average labor productivity A^y, then the response to an aggregate productivity shock z will have reallocative effects: following a positive shock, resources will be reallocated away from nontraded good production towards traded good production. Clearly, if $pA^x = A^y$, both sectors respond identically to aggregate shocks.

Consider now the response to relative price shocks, arguably the novel feature of this model. Inspecting the definition of the surplus function (15), the first thing to notice is that the relative price enters twice. First it directly affects the current profits of the traded sector production units. Second, it also changes the price index and the discount factor for future profits, $\frac{\beta q_s}{q_{s'}}$, since under our assumptions an increase in the price of tradables increases the aggregate price index. For an easier interpretation, define $R_{ss'} = \frac{q_{s'}}{\beta q_s}$. $R_{ss'}$ is the –implicit– state contingent real interest rate in terms of nontradables. Evidently, the real interest rate will be high when the price of tradables is expected to increase, or equivalently, when there is an expected depreciation. This form of interest rate parity has to hold in this model under the assumption of risk neutrality.

A higher interest rate decreases the value of production units in both sectors and may trigger a shutdown. Hall (1997b) has emphasized the empirical and theoretical importance of fluctuations in the real interest rate on the shutdown margin. While the current model emphasizes mostly fluctuations in current profits as a source of aggregate dynamics, it is worth pointing out that expected variations in the price of one good generically affect the discount rate faced by producers of the remaining goods.

Finally, I characterize the dynamics of the labor market. The timing is as follows. At the beginning of period t, employment level is E_t^j in sector j. Clearly, $E_t^j = \int_{\epsilon_{\hat{s}}^j}^{\epsilon_u} E_t^j(\epsilon)\,d\epsilon$ where the state in period $t-1$ was $\hat{s}$. A new aggregate state s is realized. Consequently, all units with a productivity level ϵ below ϵ_s^j are scrapped and the workers return to unemployment. Among the remaining units, $E_t^j - \int_{\epsilon_l}^{\epsilon_s^j} E_t^j(\epsilon)\,d\epsilon$, a fraction $\lambda G(\epsilon_s^j)$ experiences a new idiosyncratic shock ϵ with a value below the new cut-off. Workers who are unemployed at the beginning of period t are assumed to search for a new job – and potentially be rematched– within the period. A fraction μ_s^j of those unemployed finds a job at productivity level ϵ_u. In summary:

$$\begin{aligned}
E_{t+1}^j(\epsilon) &= (1-\lambda)E_t^j(\epsilon) + \lambda G'(\epsilon)\,(E_t^j - \int_{\epsilon_l}^{\epsilon_s^j} E_t^j(\tilde{\epsilon})\,d\tilde{\epsilon}) && \text{for } \epsilon_s^j < \epsilon < \epsilon_u \\
E_{t+1}^j(\epsilon) &= (1-\lambda)E_t^j(\epsilon) + \lambda G'(\epsilon)\,(E_t^j - \int_{\epsilon_l}^{\epsilon_s^j} E_t^j(\tilde{\epsilon})\,d\tilde{\epsilon}) + && \text{for } \epsilon = \epsilon_u \qquad (18)\\
&\quad + \mu_s^j(1 - (1-\lambda G(\epsilon_s^x))\,(E_t^x - \int_{\epsilon_l}^{\epsilon_s^x} E_t^x(\tilde{\epsilon})\,d\tilde{\epsilon}) - (1-\lambda G(\epsilon_s^y))\,(E_t^y - \int_{\epsilon_l}^{\epsilon_s^y} E_t^j(\tilde{\epsilon})\,d\tilde{\epsilon})) \\
E_{t+1}^j(\epsilon) &= 0 && \text{for } \epsilon \le \epsilon_s^j
\end{aligned}$$

Total job creation in sector j is thus:

$$\mu_s^j(1 - (1-\lambda G(\epsilon_s^x))\,(E_t^x - \int_{\epsilon_l}^{\epsilon_s^x} E_t^x(\tilde{\epsilon})\,d\tilde{\epsilon}) - (1-\lambda G(\epsilon_s^y))\,(E_t^y - \int_{\epsilon_l}^{\epsilon_s^y} E_t^y(\tilde{\epsilon})\,d\tilde{\epsilon}))$$

However, observed job creation does not take into account jobs that are rematched within the period, within the same sector. Observed job creation in sector j is thus:

$$JC_t^j = \mu_s^j(1 - E_t^x - E_t^y + \int_{\epsilon_l}^{\epsilon_s^i} E_t^i\left(\tilde{\epsilon}\right) d\tilde{\epsilon} + \lambda G\left(\epsilon_s^i\right)\left(E_t^i - \int_{\epsilon_l}^{\epsilon_s^i} E_t^i\left(\tilde{\epsilon}\right) d\tilde{\epsilon}\right)) \tag{19}$$

The last two terms inside the parenthesis (indexed by i) refer to the jobs destroyed in sector i and rematched in sector j within the period. Similarly, observed job destruction is given by:[40]

$$JD_t^j = (1 - \mu_s^j)(\int_{\epsilon_l}^{\epsilon_s^j} E_t^j\left(\tilde{\epsilon}\right) d\tilde{\epsilon} + \lambda G(\epsilon_s^j)(E_t^j - \int_{\epsilon_l}^{\epsilon_s^j} E_t^j\left(\tilde{\epsilon}\right) d\tilde{\epsilon})) \tag{20}$$

4.3. Specification and Calibration. The purpose of this section is to evaluate the ability of the model to replicate salient features of the data. To do so, I follow the tradition in the business cycle literature and "calibrate" the model against sample moments. The two sources of aggregate fluctuations in the model are the productivity shocks z, and relative price shocks p.

To calibrate the real exchange rate shocks, I fit an AR(1) process to the log of the industry-specific real exchange rate in the sample. The average estimated autoregression coefficient across traded sectors is 0.916 with a standard deviation of the exchange rate innovations equal to 0.035.[41] I take this average AR representation as

[40]Given our definitions: $E_{t+1}^j = E_t^j + JC_t^j - JD_t^j$.

[41]A similar estimation in deviations from a linear trend yields an average autoregression coefficient of 0.90 with a standard deviation for the innovations of 0.034. A Philips-Perron test allowing autocorrelation of the residuals at 12 lags rejects the unit root hypothesis for three sectors: Cordage and Twine (SIC 2298) with a serial correlation of 0.81, Leather Gloves and Mittens (SIC 3151) with 0.79 and Dolls (SIC 3942) with 0.658. Given the small sample lack of power of unit root tests, the

characterizing the exchange rate process. Assuming that the innovations are normally distributed, I use the Tauchen and Hussey (1991) method to obtain an equivalent 3-states Markov transition matrix with an identical Wold representation. I obtain:

$$p = \begin{pmatrix} 0.8597 \\ 1 \\ 1.163 \end{pmatrix} \quad ; \quad Q_p = \begin{pmatrix} 0.916 & 0.084 & 0 \\ 0.021 & 0.958 & 0.021 \\ 0 & 0.084 & 0.916 \end{pmatrix}$$

A similar method is applied to convert an AR process for aggregate productivity into a 3-states Markov chain. However, fitting an AR1 process to the quarterly deviations from a linear trend of log manufacturing output per hour yields a correlation coefficient of 0.914 with a standard deviation of the innovations of 0.009. This implies a standard deviation of aggregate innovations about 4 times smaller than the exchange rate one. I view such large difference as implausible, especially given the small contribution of real exchange rates to the forecast error MSE in the empirical section. It should be clear that one cannot hope to replicate the aggregate dynamics if the major source of fluctuations is coming from the reallocation shocks. Instead, I assume that reallocation and aggregate shocks represent similar sources of fluctuations, so that $z = p$ and $Q_z = Q_p$.

Next, I parameterize the matching function in a standard fashion:

$$m(u_t, v_t) = \min\left(k\, u_t^{\eta} v_t^{1-\eta}, u_t, v_t\right)$$

---

non-rejection of the unit root hypothesis is not particularly worrying. Studies using longer sample periods and/or multiple countries typically find a statistically significant mean reversion rate between 2.5 and 5 years, equivalent to a larger implied autoregression coefficient between 0.933 and 0.965.

This specification imposes that the worker and job matching probabilities are less than one. η represents the elasticity of the matching function with respect to unemployment while k is a scaling parameter. Blanchard and Diamond (1989) estimate an aggregate matching function and find mild support for a constant return specification with $\eta = 0.4$. Their measure of new hires includes flows into employment from unemployment, out of the labor force and employment minus recalled workers. These authors find that the flows into employment from out of the labor force are roughly of the same magnitude as the flows into employment from unemployment.[42] Haan et al. (1997) and Cole and Rogerson (1996) have also pointed out that part of the out of the labor force population must be included when calibrating worker matching probabilities. Otherwise, worker matching probabilities based on unemployment duration (on average 21 weeks), yield a far too rapid adjustment of the unemployment rate to its steady state value.

The average job destruction rate in the traded and non-traded sectors are $\rho^x = 0.0576$ and $\rho^y = 0.0567$ respectively (see Table 2). To obtain the average worker matching probabilities, observe that in steady state the number of jobs created $\mu^x u$ must equate the number of jobs destroyed $\rho^x E^x$. A similar equation holds for the nontraded sector. From Blanchard and Diamond (1990), one gets an estimate of the ratio of unmatched to matched workers $\frac{u}{E^x+E^y}$ around 12%, where out of of the labor force workers are considered as part of the pool of unmatched workers. Lastly, since tradable and nontraded employment represent respectively 14.54%and 12.11% of total

[42]Blanchard and Diamond (1989) adjust the CPS flow data using the Abowd and Zellner (1985) technique. However, they report that using the Poterba Summers correction yields very different results with flows from out of the labor force representing only 28% of the flows into employment from unemployment. In what follows I adopt their baseline specification.

manufacturing employment I estimate the ratio $\frac{E^x}{E^x+E^y} = 0.5455$.[43]

One can then solve for the average worker matching probabilities in both sectors, μ^x and μ^y :

$$\mu^x = 0.262; \quad \mu^y = 0.215$$

To calibrate the taste parameters γ and ϕ, I first arbitrarily set ϕ equal to 1 so that γ represents the share of current expenditures on tradables. Using the definition of the trade balance, the trade balance to output ratio is equal to $\frac{TB}{px+y} = \frac{x-\frac{\gamma}{1-\gamma}y}{px+y}$. The average trade balance to GDP ratio is equal to -1.28% over the sample period 1972-1988. This allows to pin down γ, the share of traded goods in expenditures. Note that γ indirectly affects the strength of the interest rate effect discussed previously. A smaller γ implies less variation in the price index and therefore a smaller fluctuation in the real interest rate in response to exchange rate shocks. While γ pins down the relative importance of tradables and nontradables in consumption, one also needs to calibrate the relative importance of both sectors in production. For lack of a direct estimate of the average relative productivity of traded and nontraded goods, I assume in what follows that $A^x = A^y$.

The discount rate β is set so that the annualized interest rate is equal to 4%; the idiosyncratic shocks ϵ are distributed uniformly with mean 0 on $[-\epsilon_u, \epsilon_u]$ where the range ϵ_u will be calibrated to the match the average standard deviation of the job destruction series in both sector.

Table 9 reports the main parameters together with the moments that need to be

[43]This implicitly assumes that the ratio is 54% for the entire economy.

Table 9: CALIBRATION

Definition	Parameter	Value
Consumers		
discount rate	β	0.99
elasticity of substitution between x and y	ϕ	1.00
share of traded goods x	γ	0.532
Technology		
average productivity, tradables	A^x	0.028
average productivity, non-tradables	A^y	0.028
arrival rate of idiosyncratic shocks	λ	0.184
Range of idiosyncratic shock	ϵ_u	1.879
search cost per period	ν	0.006
Matching		
elasticity of the matching function	η	0.40
worker share of surplus	δ	0.40
matching function scale parameter	k	0.086
Moments	data	model
Trade balance output ratio	-0.0128	-0.016
Unemployment	0.12	0.126
Worker matching probability (traded)	0.262	0.262
Worker matching probability (non traded)	0.215	0.223
Standard deviation of job creation (traded)	0.0096	0.013
Standard deviation of job creation (non-traded)	0.0080	0.012
Mean Job Destruction (traded)	0.057	0.091
Mean Job Destruction (non traded)	0.056	0.089

Note: Parameters estimated by Simulated Method of Moments 100 replications. Source: author's calculations

matched.[44]

4.4. Simulation and discussion of the results: the role of the opportunity cost of employment.

For the calibrated values of the parameters, Table 10 reports the cut-off as well as the job and worker matching probabilities.[45]

We observe a few points. First, the cut-off declines in the tradable sector as both

[44]The parameters are estimated by Simulated Method of Moments. I use a sample of length 2000 and delete the first 500 observations to reduce dependence on initial conditions. Since there is no growth in the model, the correlation structure is estimated in levels. With 8 moments and 6 parameters, the estimation is overidentified.

[45]The states are in a lexicographic order with the aggregate shock first.

Table 10: CUT-OFFS AND MATCHING PROBABILITIES

State	Aggregate	Relative Price	*Tradable* Cut-Off	Job Matching	Worker Matching	*NonTradable* Cut-Off	Job Matching	Worker Matching	Overall Worker Matching
1	0.8597	0.8597	0.434	0.046	0.219	0.191	0.043	0.246	0.464
2	0.8597	1.0000	0.314	0.044	0.234	0.314	0.044	0.234	0.467
3	0.8597	1.1631	0.191	0.043	0.247	0.439	0.046	0.219	0.465
4	1.0000	0.8597	0.397	0.045	0.226	0.128	0.042	0.256	0.482
5	1.0000	1.0000	0.266	0.043	0.243	0.266	0.043	0.243	0.485
6	1.0000	1.1631	0.133	0.042	0.257	0.400	0.045	0.226	0.483
7	1.1631	0.8597	0.347	0.044	0.235	0.054	0.040	0.268	0.503
8	1.1631	1.0000	0.204	0.042	0.253	0.203	0.042	0.253	0.506
9	1.1631	1.1631	0.058	0.040	0.268	0.351	0.044	0.235	0.503

Note: The table reports the cut-offs and the matching probabilities in the traded and non-traded sectors. Source: author's calculations

the relative price and the aggregate productivity improve. In the nontraded sector, the cut-off increases with the reallocation shock and decreases with the aggregate shock. Similarly, we observe that the worker matching probabilities increase in the tradable sector with positive aggregate and reallocation shocks, implying a decline in the job matching rate. Destruction rates in this model, can be read off directly from the change in the cut-off. Suppose, to simplify, that the economy has enough time to reach its ergodic distribution $\bar{E}^j(\epsilon)$ between each shock. Then, following an adverse shock that shifts the state from s to s', approximately $\int_{\epsilon_s^j}^{\epsilon_{s'}^j} \bar{E}^j(\epsilon)\, d\epsilon$ jobs are destroyed if $\epsilon_s^j < \epsilon_{s'}^j$.

The interesting question is what happens to job creation. From table 10, we know that an adverse shock, whether aggregate or reallocation, lowers the worker matching rate. Going from the highest to the lowest aggregate productivity state, the matching rate drops by 20%, from 0.268 to 0.219 in each sector. This decline in matching rates can result from an increase in unemployment or a decline in vacancies posted. Its effect is clearly to dampen the opportunity cost of employment. In turn, a decline in the opportunity cost of employment indicates that it is profitable to try to hire labor. This mechanism is central to all reorganization models of the business cycle: reallocation occurs efficiently when the opportunity cost of reorganization is lowest, i.e. when nonmarket activity, such as search, are relatively more productive. The subsequent large increase in unemployment lowers the opportunity cost of labor and triggers massive entry so that unemployment is both large and very short lived. The result is a strong synchronization between entry and exit margins. Central to this argument is the feedback mechanism from the destruction margin to the opportunity cost of employment that in turn activates the entry margin. Consider now the case of a reallocation shock. If anything, the feedback mechanism *must* be less effective. The reason for this is that the opportunity cost of labor remains abnormally high, from the point of view of the depressed sector, since the reallocation shock increases entry in the other sector. One can clearly see this effect at work by looking at the last column of table 10, reporting the overall worker matching rate $\mu_s^x + \mu_s^y$. The overall matching rate varies substantially in response to aggregate shocks, from a low of 0.46 to a high of 0.50, but remains almost entirely unaffected by changes in the relative price. To see why this is the case, suppose we adopt the perspective of the central planner.[46] Following a reallocation shock, the optimal response consists in reallocating labor *between* sectors since one sector is expanding and the other one is contracting. The opportunity cost of labor remains muted so that there is less of a feddback on the entry margin. In turn, this implies that we should observe less of a correlation between job creation and destruction at the intra-sectoral level.

[46]As usual since the sole source of inefficiency in this economy results from the search externalities, efficiency can be restores if $\delta = \eta$. See Hosios (1990). The cut-off and matching probabilities are mostly unchanged if I impose $\delta = \eta = 0.5$.

Table 11: DYNAMIC CORRELATION JC^j_{t+k}, JD^j_t

SECTOR:	k	-3	-2	-1	0	1	2	3
Aggregate	Data	-0.24	-0.12	-0.27	-0.35	-0.06	0.27	0.25
	Agg.	0.09	0.11	0.14	0.17	0.76	0.57	0.41
	Real.	-0.10	-0.13	-0.15	0.17	0.75	0.41	0.17
	Both	0.02	0.08	-0.01	0.35	0.68	0.39	0.20
Non Traded	Data	-0.09	-0.03	0.01	0.02	0.013	0.15	0.31
	Agg.	0.09	0.11	0.14	0.17	0.76	0.57	0.41
	Real.	-0.24	-0.27	-0.28	-0.43	-0.02	-0.08	-0.12
	Both	-0.03	-0.09	-0.17	-0.35	0.11	0.02	-0.08
Traded	Data	-0.14	-0.24	-0.38	-0.43	0.002	0.0001	0.006
	Agg.	0.09	0.11	0.14	0.17	0.76	0.57	0.41
	Real.	-0.18	-0.21	-0.23	-0.36	0.15	0.09	0.02
	Both	-0.21	-0.14	-0.17	-0.25	0.13	0.07	0.08
Exporters	Data	-0.46	-0.35	-0.34	-0.24	-0.14	0.05	0.16
Import-Competing	Data	-0.24	-0.12	-0.27	-0.35	-0.07	0.27	0.25

Note: The table reports the dynamic correlation at various leads and lags between sectoral and aggregate job creation and destruction rates. Simulation results obtained from 100 simulations. Source: LRD and author's calculations

To confirm this intution, Table 11 reports the dynamic correlation between job creation and destruction both at the aggregate and sectoral level, from the data and from simulations of the calibrated model. It is important to note that the calibrated parameters do not attempt to replicate the dynamic correlation between job creation and destruction. As a result, it is perhaps not too surprising that the model does not replicate the overall correlation between creation and destruction (the simulation predicts a correlation of 0.35 in presence of both shocks and 0.17 in presence of aggregate shocks only). This failure indicates a stronger reallocation mechanism in the model than in the data: job creation picks up on the tails of job destruction. The table further decomposes the correlation into the components resulting from the aggregate and reallocation shocks respectively. The correlation of *total* job creation and destruction rates is similar in response to reallocation shocks than aggregate shocks. This is the effect discussed by Lilien (1982): a reallocation shock increases job creation in one sector and job destruction in the other, leading to a positive comovement in the overall job creation and destruction rates. However, this aggregate positive comovement masks a lower comovement at the *sectoral* level. The contemporaneous correlation between job creation and destruction in the traded and nontraded sector is 0.17 in the case of aggregate shocks but falls to -0.36 (resp. -0.43) in the case of allocative disturbances. Reallocative shocks in this model trigger an intersectoral reallocation response, as opposed to an intra-sectoral reallocation.

The lower within-sector correlation points to the difficulty faced by the model: if the model aims at replicating the negative comovements in response to aggregate shocks (and negative overall comovements), the opportunity cost channel must be sufficiently weak. However, in that case, a relative price shock will also lead to a negative correlation of within sector gross flows. Lastly, figure 5 reports the impulse response to an aggregate and a relative price shock, as generated by the model.[47] The figure reports the response to a decrease in aggregate productivity and a real appreciation. An aggregate shock imparts similar dynamics in both the traded and non-traded sectors, with a surge in job destruction followed by a mild increase in job creation. By contrast, an appreciation triggers a surge of job destruction in the traded goods sector and a simultaneous increase in job creation in the non-traded goods sector. While the aggregate effect is a strong positive comovement of job creation and destruction, the sectoral gross flows move clearly in opposite directions.

Observe also that the problem is not solved by decoupling job creation and destruction in response to aggregate shocks. If anything, this implies an even lower algebraic correlation between sectoral flows.

[47] The impulse response is generated by assuming that the system is initially in steady state.

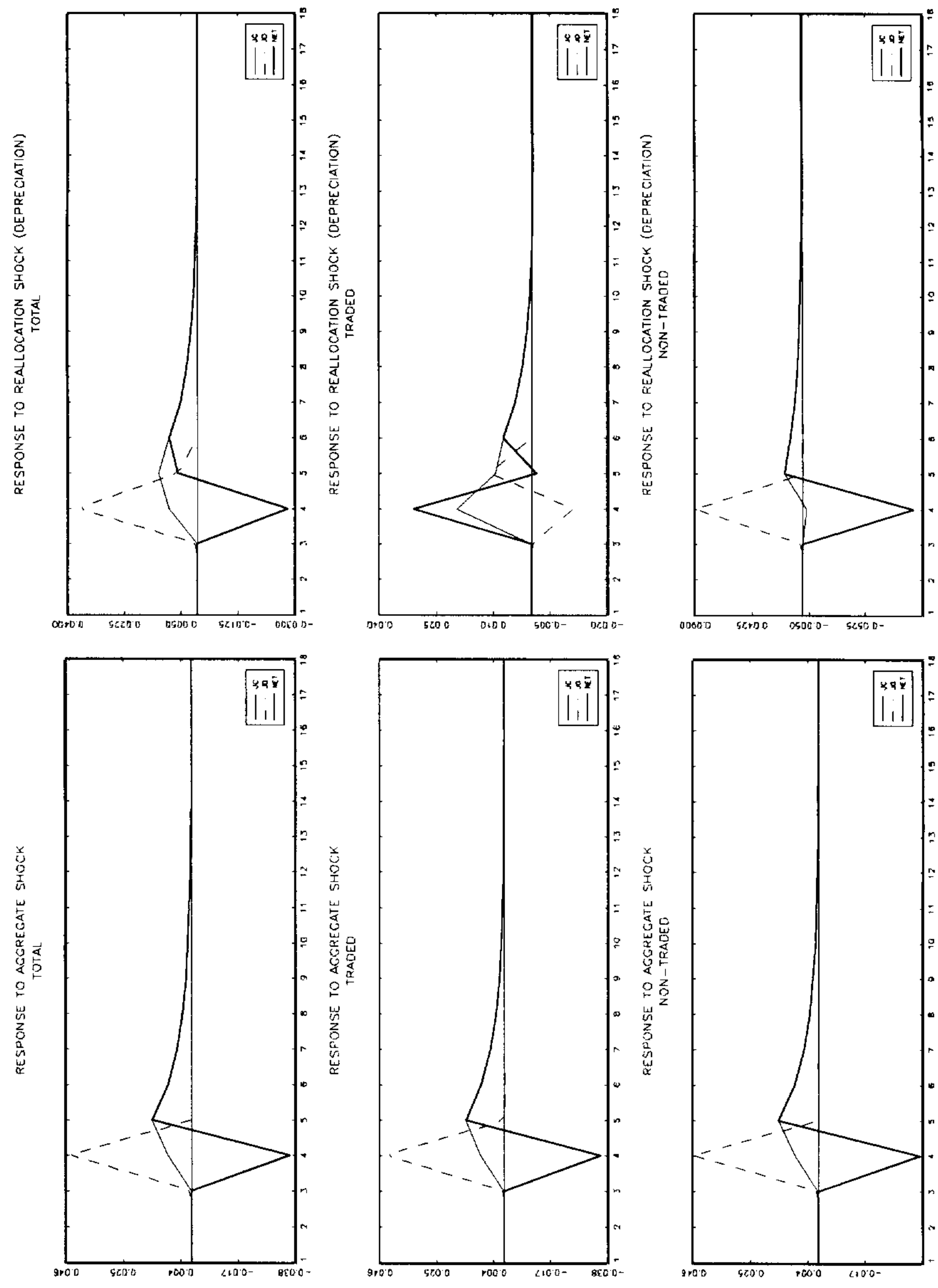

Figure 5: Normalized Impulse Response Functions to Aggregate and Sectoral Shocks. Simulated Model.

This result indicates the difficulty faced by this type of models: to generate a positive comovement between sectoral job creation and job destruction, it needs to generate a positive comovement between job creation and destruction in response to an aggregate shock. The tension between the two requirements indicate some other mechanism is required. Clearly, while a great deal of effort has been spent on the dynamics of the shutdown margin, we need to think more actively about the dynamics of the entry margin and recoveries. The results in the paper indicate point to a difference in the dynamic response that cannot be accommodated within the current framework.

5. Conclusion

This paper aimed at uncovering the relationship between factor adjustment and real exchange rate fluctuations. Concentrating on gross job flows in the US manufacturing sector, it was found that exchange rate movements affect significantly both net and gross factor reallocation. In the paper's benchmark estimation, a 10% appreciation of the real exchange rate translates into a contraction in tradable employment of roughly 0.3%, trough a simultaneous increase in job destruction and job creation. The effect is mostly concentrated in import-competing industries which exhibit much higher exchange rate sensitivity. While these effects are significant, it also appears that exchange rate shocks do not constitute a major source of fluctuations at the sectoral level. We found only roughly 9 to 11% of the 8 quarters ahead forecast MSE accounted for by real exchange rate movements.

Perhaps more strikingly, the results indicate a pattern of adjustment in response to reallocative shocks essentially different from the response to aggregate shocks. While aggregate dynamics are characterized by a strong decoupling between job creation and destruction, reallocative shocks (oil shocks in Davis and Haltiwanger (1997) or real exchange rate shocks in this paper) induce positive comovements in sectoral gross flows. In the context of real exchange rates, appreciations are times of turbulence, with a joint increase in creation and destruction while depreciations are times of 'chill'.

Lastly, the paper has presented a canonical 2 sector business cycle model with employment reallocation and argued that the pattern found in the data is hard to replicate in current models or reallocation. This should provide fertile ground for further theoretical and empirical investigations.

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6. APPENDIX: SIC CODES FOR TRADABLE AND NONTRADABLE INDUSTRIES.

This appendix reports the 4-digit SIC codes of the traded and non-traded industries. For each four digit industry, Tables 12 and 13 report the average import penetration and export share (last two columns). The table also reports the average employment share of the nontradable, exporters and import-competing industries at the one and two digit levels (bold numbers in the labor share column) as well as the decomposition of the total labor force in each sector by industry. For instance, 28% of Instruments (SIC 38) employment is in export industries and 4.06% in import-competing industries. Conversely, Instruments represents about 2.06% of Import-competing employment and 8% of Exporters' employment. This last number is obtained by summing the appropriate 4-digit labor shares $(1.43\% + 4.17\% + 2.31\%)$.

Table 12: Nondurables SIC codes, sector classification, exposure and labor share.
Source: LRD, NBER Trade database and author's calculations

Code	Sector	NonTraded	Export *Labor Share*	Import Comp.	Import Pen.	Export Share
	NONDURABLE GOODS	**22.94%**	**2.14%**	**5.41%**		
	Food and Kindred Products	**52.05%**	**2.63%**	**2.51%**		
2016	Poultry dressing plants	7.02%			0.18%	2.97%
2017	Poultry and egg processing	1.18%			0.19%	2.97%
2022	Cheese, natural and processed	1.87%			3.50%	0.23%
2024	Ice cream and frozen desserts	0.97%			0.01%	0.11%
2026	Fluid milk	3.12%			0.05%	0.11%
2032	Canned specialties	1.68%			0.47%	0.97%
2034	Dried and dehydrated fruits, vegetables and soup mixes		1.00%		5.13%	16.25%
2038	Frozen specialties	2.69%			0.74%	0.42%
2044	Rice milling		0.36%		1.65%	52.40%
2048	Prepared feeds and feed ingredients for animals and fowls, not elsewhere classified	1.68%			0.41%	2.34%
2051	Bread and other bakery products, except cookies and crackers	7.51%			0.74%	0.26%
2052	Cookies and crackers	2.68%			0.75%	0.26%
2075	Soybean oil mills		0.57%		0.08%	18.09%
2076	Vegetable oil mills, except corn, cottonseed, and soybean		0.08%		9.66%	34.44%
2077	Animal and marine fats and oils		0.76%		3.40%	33.10%
2082	Malt beverages	2.38%			4.36%	0.48%
2084	Wines, brandy, and brandy spirits			0.78%	26.89%	1.55%
2085	Distilled, rectified, and blended liquors			1.26%	24.39%	3.69%
2086	Bottled and canned soft drinks and carbonated waters	3.38%			0.47%	0.32%
2091	Canned and cured fish and seafoods			1.32%	30.34%	22.45%
2092	Fresh or frozen packaged fish and seafoods	1.99%			0.00%	19.24%
2097	Manufactured ice	0.23%			0.68%	0.20%
2098	Macaroni, spaghetti, vermicelli, and noodles	0.42%			5.20%	0.41%
	Tobacco Manufactures	**16.45%**				
2141	Tobacco stemming and redrying	0.55%			0.00%	0.80%
	Textile mill products			**2.13%**		
2279	Carpets and rugs, not elsewhere classified			0.20%	53.29%	3.60%
2298	Cordage and twine			0.74%	22.62%	4.37%
2299	Textile goods, not elsewhere classified			0.52%	48.40%	16.78%
	Apparel and other textile product	**2.34%**		**2.02%**		
2381	Dress and work gloves, except knit and all-leather			0.96%	35.07%	5.01%
2385	Raincoats and other waterproof outer garments			1.19%	44.31%	5.82%
2386	Leather and sheep lined clothing			0.65%	60.55%	9.77%
2396	Automotive trimmings, apparel findings, and related products machine embroideries	1.79%			0.52%	0.41%
	Paper and allied products	**29.12%**	**2.38%**	**23.04%**		
2611	Pulp mills		1.09%	1.42%	35.07%	50.69%
2621	Paper mills, except building paper mills			12.47%	15.83%	4.65%
2642	Envelopes	1.54%			0.14%	0.34%
2651	Folding paperboard boxes	2.68%			0.28%	0.69%
2652	Set-up paperboard boxes	0.88%			0.28%	2.68%
2653	Corrugated and solid fiber boxes	5.86%			0.28%	0.79%
	Print and publishing	**54.17%**				
2711	Newspapers: publishing, publishing and printing	12.17%			0.24%	0.06%
2721	Periodicals: publishing, publishing and printing	1.11%			0.60%	2.85%
2741	Miscellaneous publishing	1.45%			0.97%	0.54%
2761	Manifold business forms	3.09%			1.52%	0.11%
	Chemicals and allied products		**11.83%**	**1.65%**		
2819	Industrial inorganic chemicals, not elsewhere classified		4.09%		13.54%	19.57%
2822	Synthetic rubber (vulcanizable elastomers)		0.67%		8.39%	21.50%
2833	Medicinal chemicals and botanical products		0.72%	0.95%	29.42%	49.95%
	Petroleum and coal products		**1.10%**			
2999	Products of petroleum and coal, not elsewhere classified		0.08%		4.62%	53.58%
	Rubber and misc. plastic products			**2.75%**		
3021	Rubber and plastics footwear			1.99%	42.81%	4.11%
	Leather and leather goods			**67.28%**		
3143	Men's footwear, except athletic			5.09%	26.52%	2.59%
3144	Women's footwear, except athletic			5.48%	46.69%	1.50%
3149	Footwear, except rubber, not elsewhere classified			2.18%	65.24%	8.59%
3151	Leather gloves and mittens			0.50%	29.99%	5.65%
3171	Women's handbags and purses			1.73%	45.83%	2.41%

Table 13: Durables SIC codes, sector classification, exposure and labor share.
Source: LRD, NBER Trade database and author's calculations

Code	Sector	NonTraded	Export	Import Comp.	Import Pen.	Export Share
			Labor Share			
	DURABLE GOODS	**6.61%**	**15.94%**	**5.84%**		
	Lumber and Wood Products	**4.23%**	**12.34%**	**3.22%**		
2411	Logging camps and logging contractors		5.14%		0.89%	18.73%
2435	Hardwood veneer and plywood			2.11%	29.30%	6.45%
2441	Nailed and lock corner wood boxes and shook	0.54%			0.94%	0.49%
2448	Wood pallets and skids	1.54%			0.94%	0.77%
	Furniture and fixtures	**7.72%**				
2515	Mattresses and bedsprings	1.54%			6.75%	0.65%
	Stone, clay and glass products	**32.12%**		**4.27%**		
3251	Brick and structural clay tile	1.20%			1.62%	0.71%
3253	Ceramic wall and floor tile			0.81%	32.35%	1.73%
3262	Vitreous china table and kitchen articles			0.64%	43.79%	5.92%
3269	Pottery products, not elsewhere classified			0.99%	51.93%	12.22%
3271	Concrete block and brick	0.96%			0.46%	0.10%
3272	Concrete products, except block and brick	3.55%			0.46%	0.34%
3273	Ready-mixed concrete	4.75%			0.01%	0.00%
	Primary metal industries			**3.81%**		
3313	Electrometallurgical products			0.65%	37.33%	6.85%
3333	Primary smelting and refining of zinc			0.32%	48.08%	1.04%
3339	Primary smelting and refining of nonferrous metals, not elsewhere classified			0.79%	56.58%	67.42%
3341	Secondary smelting and refining of nonferrous metals			1.49%	27.79%	15.21%
	Fabricated metal products	**14.78%**				
3411	Metal cans	3.55%			0.91%	0.49%
	Machinery, except electrical		**37.14%**	**1.90%**		
3519	Internal combustion engines, not elsewhere classified		5.22%		11.60%	20.84%
3531	Construction machinery and equipment		8.23%		8.07%	32.06%
3532	Mining machinery and equipment, except oil field machinery and equipment		1.31%		8.07%	22.99%
3533	Oil field machinery and equipment		3.22%		8.07%	55.07%
3542	Machine tools, metal forming types		1.31%		9.91%	27.04%
3547	Rolling mill machinery and equipment		0.42%		11.78%	24.95%
3551	Food products machinery		1.87%		14.01%	18.89%
3552	Textile machinery		1.48%	1.93%	38.89%	27.77%
3554	Paper Industries machinery		0.92%		17.80%	21.17%
3555	Printing trades machinery and equipment		1.42%		17.45%	24.48%
3561	Pumps and pumping equipment		3.51%		5.66%	16.83%
3563	Air and gas compressors		1.58%		10.53%	23.27%
3573	Electronic computing equipment		10.22%		14.09%	28.09%
3574	Calculating and accounting machines, except electronic computing equipment			1.05%	31.34%	17.77%
	Electrical and electronic equipment		**10.08%**	**3.61%**		
3636	Sewing machines		0.35%	0.46%	53.79%	46.11%
3651	Radio and television receiving except communication			5.62%	47.80%	13.38%
3674	Semiconductors and related devices		7.41%		24.87%	30.71%
3693	X-Ray Equipment		1.56%		15.88%	27.31%
	Transportation equipment	**8.77%**	**30.08%**	**20.41%**		
3711	Motor vehicles and passenger car bodies			30.87%	23.38%	7.82%
3713	Truck and bus bodies			4.17%	23.38%	7.82%
3721	Aircraft		12.60%		3.56%	30.84%
3724	Aircraft engines and engine parts		6.73%		6.43%	18.90%
3728	Aircraft parts and auxiliary equipment, not elsewhere classified		7.73%		9.10%	39.09%
3731	Ship building and repairing	9.59%			0.00%	4.77%
3751	Motorcycles, bicycles, and parts			1.27%	52.75%	10.85%
	Instruments and related products		**28.00%**	**4.06%**		
3823	Industrial instruments for measurement, display, and control of process variables		2.31%		8.51%	20.24%
3825	Instruments for measuring and testing of electricity and electrical signals		4.17%		8.50%	25.16%
3829	Measuring and controlling devices, not elsewhere classified		1.43%		8.50%	47.84%
3873	Watches, clocks, clockwork operated devices, and parts			2.06%	43.37%	8.71%
	Misc. manufacturing industries	**17.83%**	**1.81%**	**16.23%**		
3911	Jewelry, precious metal			2.87%	42.68%	6.58%
3914	Silverware, plated ware, and stainless steel ware			0.84%	22.95%	7.39%
3915	Jewelers' findings and materials, and lapidary work		0.43%	0.57%	43.11%	66.05%
3942	Dolls			0.65%	57.03%	6.40%
3962	Feathers, plumes, and artificial trees and flowers			0.40%	37.35%	4.22%
3993	Signs and advertising displays	2.87%			0.33%	1.04%