Essays on International Economics and Labor Markets

by

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Abstract

This thesis consists of three separate essays related to international economics and labor markets. The first essay, with Francisco Gallego, looks at sudden stops, a main feature of developing countries in the last decades, and their effects on these countries. Using sector-level data on job flows for four Latin American countries, we find that sudden stops are associated with lower job creation and increased job destruction. Sectoral effects are related to financial indicators: sectors with higher dependence on external financing experience lower creation and sectors with high indicators of liquidity needs experience larger destruction. These results provide evidence of financial conditions being an important transmission channel of sudden stops within a country.

The second essay, with Patricia Cortés, studies whether low-skilled immigration has led high-skilled American women to change their time use decisions. We find evidence that low-skilled immigration has increased hours worked by women with a graduate degree, especially those with a professional degree or a PhD and those with children. Our estimates suggest that the low-skilled immigration flow of the 1990s increased by 7 and 33 minutes a week the average time of market work of women with a Master's and a professional degree or a PhD, respectively. Low-skilled immigration increases the fraction of high-skilled women working more than 50 (and 60) hours a week, but decreases their labor force participation. Consistently, for these women, a decrease in the time spent in household work and an increase in reported expenditures on housekeeping services. Low-skilled immigration does not affect other education groups, except for a negative effect on labor supply.

The third essay focuses on the effects of trade in services, modeled as formation of international production teams, in a diversity and trade model à la Grossman and Maggi (2000). For the two country case it is shown that when the tails of the countries' talent distributions satisfy a "similarity" condition, then free trade in goods replicates the integrated equilibrium. However, this condition is strong and it implies that generally international teams will change the allocation of agents, when trade in goods is already possible.

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Introduction

In a world that becomes more and more integrated with time, interactions between countries have become an important are of study in economics. We also know that labor markets are one of the most important components of an economy, they reflect not just static allocation of resources across sectors and labor supply decision, but they also have an extremely important dynamic dimension. In this dissertation I present three different studies that relate open economy issues and labor markets. Each of the chapters in this dissertation studies one phenomenon observed in open economies where, directly or indirectly, labor markets are an important piece understanding their effects.

Outline

In the first chapter, joint work with Francisco Gallego, we study the *sudden stops* and international financial crises that have been a main feature of developing countries in the last 25 years. While their aggregate effects are well known, the microeconomic channels through which they work have yet to be explored. In this paper we study their effects on microeconomic variables related to job flows using sectoral panel data for four Latin American countries.

Our empirical results suggest that sudden stops are associated with lower job creation and increased job destruction. Furthermore, these effects are heterogeneous across sectors and across countries. Sectors with higher dependence on external financing experience lower creation. A similar result is observed in sectors with higher indicators of liquidity needs, which experience significantly larger negative job flows, an effect particularly robust among continuing firms. Finally, we find a negative correlation between a country's firing and dismissal costs and labor destruction during sudden stops, mostly affecting the decisions of continuing firms. Our results provide evidence of financial conditions being an important transmission channel of sudden stops within a country. Moreover, they also highlight the relevance of financial factors in the restructuring process in general.

The second essay, joint with Patricia Cortés, we look at another dimension of the effects of immigration on the host country. Our interest in this questions starts from the observation that low-skilled immigrants, who have in recent decades doubled their share in the US labor force, represent a significant fraction of the labor employed in service sectors, particularly in close substitutes of household work like housekeeping, gardening and babysitting services. Based on these previous results, we proceed to study whether the increased supply of low skilled immigrants, has led high-skilled women, who have the highest opportunity cost of their time, to change their time use decisions.

Our results confirm that immigration is indeed affecting the labor supply decision of high-skilled women. In particular, we find evidence that low-skilled immigration has increased hours worked by women with a graduate degree, especially those with a professional degree or a PhD, and those with children. The estimated magnitudes suggest that the low-skilled immigration flow of the 1990s increased by 7 and 33 minutes a week the average time of market work of women with a Master's degree and women with a professional degree or a PhD, respectively. Consistently, we find a decrease in the time highly skilled women spend in household work and an increase in their reported expenditures on housekeeping services. We also find that the fraction of women in this group working more than 50 (and 60) hours a week increases with low-skilled immigration, but that labor force participation decreases at the same time. Except for a similar effect on labor force participation, there is no evidence of similar effects for any other education group of the female population. Moreover, we find that the pattern of the effects across education groups and within education group according to gender and household composition are consistent with our initial hypothesis that the effects are transmitted through the market for household related services, thus affecting labor supply as part of the household production and time use decisions.

Finally, it has been noted that one significant change in international trade in recent years is the growing importance of trade in services. Motivated by this observation, in the third essay of this dissertation I explore the effects that trade in services, modeled as the formation of international production teams, has in a certain class of of models of international trade with heterogeneous agents. To do this, I extend the diversity and trade model of Grossman and Maggi (2000), which allows for matching and sorting of heterogeneous agents that differ along a single characteristic, by introducing international team formation. For the two country case it is shown that when the tails of the countries' talent distributions satisfy a "similarity" condition, then free trade in goods replicates the integrated equilibrium. However, this condition is strong and it implies that generally international teams will change the allocation of agents across and within sectors, even in the presence of free trade in goods, thus enlarging the production set of the world economy when combined with free trade in goods. The basic mechanism for this result lies in the fact that international teams allow the creation of production teams that are not feasible when borders limit the pairing of agents.

Chapter 1

Sudden Stops and Reallocation: Evidence from Labor Market Flows in Latin America[1]

1.1 Introduction

Many emerging economies have suffered sudden stops of capital flows in the last three decades. For example, Rothenberg and Warnock (2006) document that between 1989 and 2005 most of the time there was at least one country experienced a *sudden stop* episode. These sudden stops have had significant impact on most macroeconomic aggregates, including output growth, domestic credit and unemployment among others.[2] While we know from the study of fluctuations and shocks in developed economies that the microeconomics behind the aggregate responses to shocks is important, with different mechanisms affecting differently firms in different sectors, little or nothing is known about the sectoral effects of sudden stops in developing countries. Most of our knowledge on the reaction of gross job flows to shock comes from the study of the effects of (smoother) macroeconomic shocks –such as recessions– on job creation and destruction in developed

[1]This chapter is joint work with Francisco Gallego. I would like to thank George-Marios Angeletos, Olivier Blanchard, Ricardo Caballero, Kevin Cowan, Francesco Giavazzi, Jeanne Lafortune, Borja Larraín, and seminar participants at Brandeis University, Carleton University, CEA-U. of Chile, Central Bank of Chile, IADB, MIT, PUC-Chile, Università Bocconi, University of Toronto, and the 2007 LACEA Meetings at Bogota for very useful comments, and Claudio Raddatz for generously sharing his data on sector level financial characteristics.

[2]For instance, output contracts by about 8% during periods of sudden stops; also, sudden stops are associated with big decreases in private credit, which are actually more persistent than the output contractions, see Calvo, Izquierdo and Talvi (2006).

countries (see Caballero (2007) and the references therein). There is also evidence that in developed countries exchange rate movements affect the process of job creation and destruction, and that sectors react differently to these movements (e.g. Gourinchas, 1998, 1999; Klein, Schuh and Triest, 2003).[3] However, no evidence has been provided with regard to the effects sudden stops have in this dimension.

This chapter extends our knowledge in this respect by looking at the effects of sudden stops –a large macroeconomic shock– on sector level job creation and destruction in a sample of Latin American countries. Sudden stops are clear big shocks to emerging economies that likely provide an extreme experiment to study the effects of negative shocks on job flows. Moreover, there are good reasons to think that the effects of sudden stops on job flows should be heterogeneous, depending on sector- and country-specific variables. Evidence on these effects is important for two reasons. First, it expands our understanding of sudden stops and their effects on countries that suffer them, particularly by taking an unexplored route looking at the microeconomics behind the observed aggregate response; this opens a channel through which we can think more about dynamics and recovery after a sudden stop. Second, they extend our existing evidence on the effects of macroeconomic shocks on reallocation and restructuring, as we look at shocks that are different from what has been explored so far –business cycles and relative price changes mostly–, and for a different set of countries.

Furthermore, given the nature of sudden stops, we might expect some of their sectoral effects to be linked to financial channels. One may expect sectors where firms depend more on external finance, to the firm, to suffer more from a negative external shock. Likewise, the same argument is true for firms that face larger liquidity needs, and hence may need to have access to liquid resources from financial institutions more often, or in larger amounts. At the same time, we know labor regulations play a role; thus, countries with more stringent labor regulations probably experience depressed job destruction and, maybe, depressed job creation too.

Overview. We use data for four Latin American countries (Brazil, Chile, Colombia, and Mexico) that we complement with some robustness checks for two additional countries for which we have a limited amount of information (Argentina and Uruguay). The sample includes data on job creation and destruction in manufacturing sectors, at the 2-digit level, and covers various time periods from 1978 to 2001.

[3] Haltiwanger, Kugler, Kugler, Micco and Pagés (2004) use the same data on job flows to study the effect of real exchange rates and tariffs on total, net and excess reallocation measures.

Following the literature on sudden stops, we identify these episodes using information on (net) capital flows to each country; our measure of sudden stops detects the quarters in which a country experienced a sudden and large decline in capital flows. Our episodes are in line with previous evidence, and most of them coincide with periods of "bunching" of sudden stops, which occur mostly around big international crises (see Calvo et al., 2006; Rothenberg and Warnock, 2006). Importantly, it has been observed these "bunching" episodes coincide with periods in which the supply of funds to emerging countries and firms with similar credit ratings in the US contracts, as documented by Gallego and Jones (2005). This evidence suggests that most sudden stops are driven mainly by external conditions and not solely by internal conditions, although that latter could make a country more sensitive to changes in external conditions.[4] The last argument is important for our identification assumption in the empirical strategy: if the sudden stops are not related to sector characteristics we can use sector differences to study the patterns of sectoral responses and their relation to sector-specific variables.[5]

Our first results relate to the general effect of sudden stops on gross job flows in our sample. We find that sudden stops are periods during which job creation decreases and job destruction increases.[6] In particular, we find the effect on destruction to be larger and more robust, suggesting that more jobs are lost during periods of distress, such as sudden stops. In the case of job creation we find weaker evidence of a negative effect of sudden stops only in the case of data coming from all plants sampled; when only continuing plants are considered we find no evidence of an effect of sudden stops on job creation at the 2-digit sector level in manufacturing.

We also find evidence on heterogeneity of the effects across sectors. Figure 1-1 presents some evidence of the differences in sector specific reactions to sudden stops. On the vertical axis we show the estimated sector specific response of job creation for subsectors within manufacturing (2-digit level sectors). This response is measured as the coefficient on the interaction of a measure of sudden stops and sector dummies after controlling for sector and time-country fixed effects. We can that the response to sudden stops is heterogeneous across sectors, beyond their effects on aggregate levels; this result implies that sudden stops trigger reallocation and restructuring changes. In order to illustrate one potential reason why sectors' responses may differ, we plot on the horizontal axis

[4]This would be the case if for example the choice of exchange rate regime makes a country more sensitive to exogenous changes in market perception. Gallego and Jones (2005) find evidence supporting this observation. Edwards (2005) finds no systematic relation between a country's capital mobility index and the probability of the country having a crisis; however, he does find some evidence that countries with higher capital mobility may face a higher cost if hit by a crisis.

[5]Later in the empirical section we elaborate on the exact identification assumption used to interpret our results.

[6]Job destruction takes only positive values, thus an increase in it values implies that more jobs are destroyed.

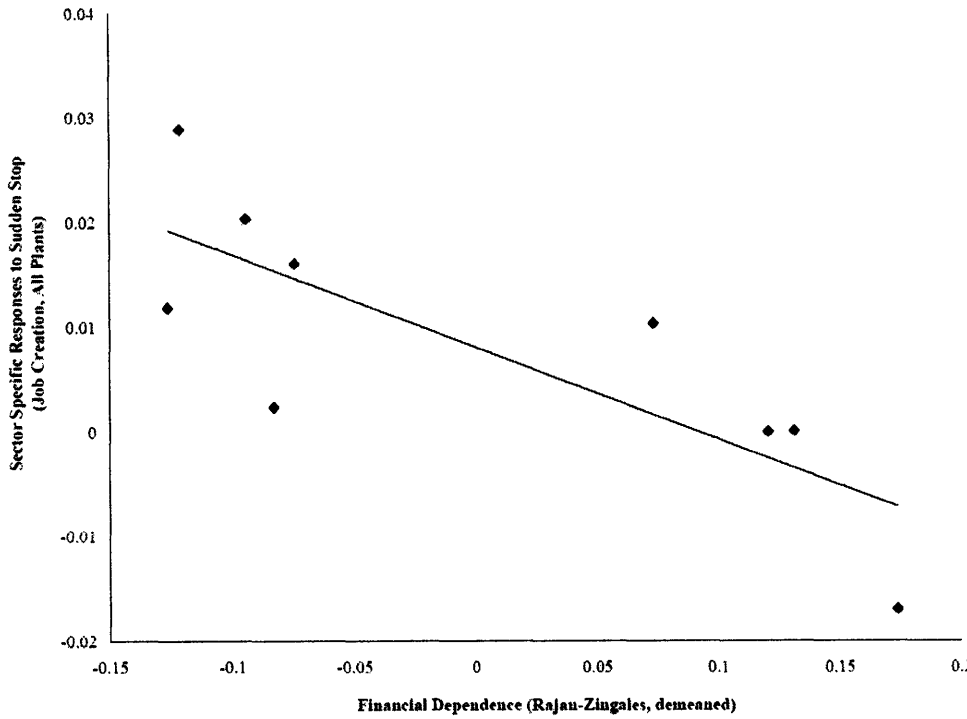

Figure 1-1. Effects of Sudden Stops on Job Creation by Sector and Financial Dependence. Each point corresponds to the estimated coefficient of the interaction of a measure of sudden stops and sector dummies in a regression of job creation on sector and country-time fixed effects, thus removing the main effect of the sudden stops. Additional controls: sector and time-country fixed effects (for a description of the variables see section 1.4.2).

the (demeaned) value of the Rajan-Zingales measure of external financing dependence by sectors; we can see that there is a negative relationship between these two sector level measures. This suggests that sectors where sudden stops trigger a larger reduction in the job creation rate are also the sectors in which firms depend more on outside funding.

Motivated by this fact, we relate the country and time variation in sector level gross job flows to country-time variation of sudden stops and to sector-country-time variation of the interaction of sudden stops with proxies for external dependence and liquidity needs of each sector. We find that the negative effect of sudden stops on job creation is stronger in sectors with stronger dependence on external finance (as captured by a Rajan-Zingales measure) as they react more than the average sector to sudden stops. Similarly, the positive effects of sudden stops on job destruction are stronger in sectors with higher indicators of financial needs (measured as the ratio of inventories over sales and the cash conversion cycle measure). We thus provide evidence that sudden stops are a significant source of reallocation and restructuring activity, and that financial conditions are an important determinant of the extent of the impact of shocks on job flows in a country. Moreover, as highlighted in our model, these variables are meant to capture two different aspects of the financial characteristics of a firm, and our empirical results seem to highlight that these two aspects are indeed related to different margins of adjustment by firms when subject to a sudden stop.

Finally, we observe some, weaker, evidence that job creation in countries with more stringent labor regulations reacts more negatively to sudden stops. Additionally, the positive effects of sudden stops on job destruction seem to be weaker in countries with more stringent labor regulations.

Our results on the sectoral effects and their association with financial characteristics are robust to changes in the sample, adding countries, using a different definition of our crisis variable, restricting the sample to the 1990s only, and to changes in the empirical specification controlling for additional sources of variation. A simple counterfactual exercise tells us that the magnitudes of the coefficients translate into sizable differences in aggregate responses, particularly so in the case of job destruction.

Layout. The chapter is organized as follows. Section 1.2 discusses some of the available evidence on sudden stops and reviews the related literature that provides a general background for this chapter. Section 1.3 presents a simple model of creation and destruction in the presence of financial constraints; we use this model as a framework for the interpretation of the empirical strategy and results. Section 1.4 discusses the data and describes the empirical strategy. Section 1.5 presents the main results of the chapter together with some robustness checks. In section 1.6 we present a summary of our conclusions and suggest directions for future research.

1.2 Discussion and Relevant Literature

Our chapter relates to several strands of literature. First and foremost, we draw from the existing literature on the characteristics of sudden stops and their aggregate effects. Dornbusch, Goldfajn and Valdes (1995) were the first to refer to reversals in financial flows as *sudden stops*; shortly thereafter, Calvo (1998) explored the basic mechanism and the implications of these reversals. More recently, Guidotti, Sturzenegger and Villar (2004) and Calvo et al. (2006) have documented the aggregate effects of sudden stops; in particular, Calvo et al. (2006) show that sudden stops are associated with a decline in GDP, TFP, investment, and domestic credit.[7] Guidotti et al. (2004) decompose the adjustment in current account into adjustment in exports and imports, and relate them to country specific characteristics; they find that countries that are more open and have lower financial dollarization adjust their current account mostly through exports, which they argue are less costly than an imports-based adjustment. This connection between export-import responses and financial dollarization is related to our approach, but they do not look at the particular factors driving the differences across sectors.

The pervasiveness of sudden stops is documented in Calvo et al. (2006) and Rothenberg and Warnock (2006), who show that sudden stops tend to come in "bunches", i.e. many countries suffer sudden stops simultaneously or with small time differences, and are fairly frequent, i.e. most of the time there is at least one country suffering a sudden stop –in line with evidence in Gallego and Jones (2005).[8] Similarly, Rothenberg and Warnock (2006) find that crisis are also frequent from a country's point of view; in their sample a country experienced on average 2.5 crises over the 16 years they study.

Another branch of the literature has taken a theoretical approach to the study of sudden stops. Caballero and Krishnamurthy (2001), and other related papers by the same authors, show how borrowing constraints, domestic and international, interact during sudden stops. In their model, the international constraint binds and the country faces a tight *external* financial constraint. In the same vein, other papers have explored the consequences of sudden stops, generally looking at aggregate variables. Using general equilibrium models, Kehoe and Ruhl (2006) and Pratap and Urrutia (2007) study the Mexican crisis of 1994-5, and Gertler, Gilchrist and Natalucci (2006) focuses on Korea's performance around the Asian crisis. More related to our hypothesis, Pratap and Urrutia (2007), and Gertler et al. (2006) incorporate financial frictions in their models and are able to match some of the salient features of the corresponding crises they study.[9] The main result from these papers is that both labor and financial market frictions improve the ability to match some stylized facts of the two sudden stops they study.

[7]Brei (2007) finds that there is a significant reduction in domestic lending by banks during sudden stops. There is also evidence that some bank characteristics are associated with lower reductions in lending growth during sudden stops.

[8]Some recent work has explored possible differences between sudden stops by looking at *gross* capital flows, separating between stops in inflows (sudden stops) and increases in outflows (sudden flight), see Rothenberg and Warnock (2006) and Cowan, De Gregorio and Neilson (2007).

[9]Also related to the literature is the work by Chari, Kehoe and McGrattan (2005) that presents a very suggestive result. They show how in a relatively standard model of a small open economy, a sudden stop modeled as a tightening of a collateral constraint can, under certain assumptions, generate an increase rather than a decrease in output. The main lesson is that other economic frictions might be needed to generate the usual output drops that accompany sudden stops.

Our work is also related to the literature on job flows, labor market dynamics and restructuring. We borrow from this literature the insight that the microeconomic channels behind the aggregate picture gives us information on the mechanisms and the effects of particular shocks and changes in economic conditions. Within this literature the study of the effects of macroeconomic shocks on job and worker reallocation in developed economies has received a lot of attention in the last years (e.g. Blanchard and Diamond, 1990; Caballero, 2007; Caballero and Hammour, 2005; Davis, Haltiwanger and Schuh, 1998; Fujita and Ramey, 2007; Hall, 2005; Shimer, 2005, 2007). These papers study how recessions are linked with periods of high job destruction and increased unemployment when analyzed from the jobs side; when looked at from the worker-flows side, these periods seem to be related to decreased transitions from unemployment to employment. Other line of research in this area has looked at the effects of labor market regulation on labor market outcomes, in particular regulations that hinder the dynamic responses to shocks, e.g. Blanchard and Portugal (2001). One conclusion from the literature on job flows and restructuring that is highly applicable to our work is that firms' reactions to (negative) shocks depend on (i) financial aspects related to the ability of entrepreneurs to raise external funds to keep the firm running, and (ii) labor regulations that determine the costs of destroying a job and the relative bargaining power of entrepreneurs. There is, however, a difference in the focus between our paper and the main work in this literature; we deal with a shock that is larger and that, at least at the country level, corresponds more to a financial shock, instead of business cycle variation or (exogenous) productivity innovations.

An important application of the literature on restructuring and reallocation deals with the effects of real exchange rates in sectoral flows in open economies. Gourinchas (1999) study the effects of real exchange rate movements on job reallocation within and across sectors in France between 1984 and 1992 using firm level data and find that exchange rate shocks generate responses in both job creation and destruction: following a real exchange depreciation, job creation and destruction decrease. Klein et al. (2003) use sectoral data for US manufacturing firms over the 1973-1993 period and study the effects of trend and cyclical variation of real exchange rates on job reallocation; they find that job destruction decreases and net employment growth increases after a depreciation of the dollar. Their findings on trend movements confirm Gourinchas's (1998) results but they also find that movements in trend real exchange rates affect both job creation and destruction in the same way.[10] Finally, Haltiwanger et al. (2004) analyze the same topic using

[10]See also Goldberg, Tracy and Aaronson (1999) and Campa and Goldberg (2001) for related work on the effects of international factors in employment and labor markets.

the same dataset used in this chapter, and confirm previous results in that real exchange rate appreciations are periods of increased job reallocation. While our methodology is related to this literature, we exploit an extreme case of an external shock, which (i) reflects countries' external financial conditions (and probably much better than the real exchange rate) and (ii) is also more exogenous to sector-specific situations across countries.

Finally, our empirical approach is also related to the literature on finance and sector level outcomes, largely started by Rajan and Zingales (1998) who studied the connection between financial development and growth in a broad sample of countries. Braun and Larraín (2005) show, using a cross-country sample of manufacturing industries over forty years, that industries that are more dependent on external finance are hit harder during recessions. In a related paper, Larraín (2006) shows that output volatility is dampened in countries with more developed bank systems, as they provide firms with more access to countercyclical borrowing. Raddatz (2006) presents evidence on the relation between output volatility, country financial development and liquidity needs at the sector level; his results show that lower financial development magnifies the effects of liquidity needs on sector level volatility. Therefore, all these three papers suggest a possible role for financial frictions in the transmission of sudden stops to sectors; either because there is a reduction in external funds as a whole or because particular sources of financing, i.e. bank lending, are affected.[11] Finally, from a broader perspective, this paper is related to the traditional financial multiplier/accelerator literature (e.g. Bernanke and Gertler, 1989; Kiyotaki and Moore, 1997).

1.3 Theoretical Framework

In this section we introduce a simple model of creation and destruction by firms facing financial constraints. The key mechanism in the model is a trade-off between size (creation) and liquidity: firms can choose a larger size at the cost of worsening their financial position ex-post in case they need liquid assets to continue operating. While we do not test the model directly in the empirical work, it does provide us with a simple framework for the interpretation of the empirical results and introduces some issues that will become relevant in the analysis of the results later on.

[11] Although not related to restructuring, Aghion, Angeletos, Banerjee and Manova (2007) present a model where financial frictions induce entrepreneurs to choose some projects that generate liquid resources; this misallocation lies behind the connection between volatility and growth they study.

1.3.1 Creation, Destruction and Financial Constraints: A Simple Model

In order to introduce the basic intuition of the model, we consider the case of a single firm. We also abstract for now from sudden stops and their effects on financial conditions.

Set-up

Consider a risk neutral entrepreneur with access to a production technology with productivity denoted by a. There are three stages in this problem. The entrepreneurs can start production units, each of them producing a units of a good whose price we normalize to 1. Each entrepreneur can create as many units as she wants or can at a cost $c(k)$, where k is the number of units created and $c(\cdot)$ is assumed to be strictly increasing and convex such that $c(0) = c'(0) = 0$, and $c'(k)$, $c''(k) > 0$.

After units are created, they are subject to a purely idiosyncratic liquidity shock θ. The entrepreneur must be able to commit θ dollars per production unit; if the need is met, the unit produces a in the next stage. If the shock is not met for a unit, this unit is destroyed and the entrepreneur will have to pay a destruction (firing) cost η in stage 2. Thus, if the entrepreneur has θk dollars, then all units survive, if not, only a fraction is saved.

Timing. The timing is as follows:

0. Entrepreneurs create k units at a cost $c(k)$. The total amount of resources they can invest is w_0.

1. After investment is made the entrepreneur faces the liquidity shock θ and has access to some liquid resources m (that are exogenous); if the entrepreneur does not have enough liquidity, the unit is destroyed. If the the unit is saved, it will generate the flow a in stage 2. The shock θ is drawn from a distribution with pdf $f(\theta)$ with support in $[0, \infty)$.

2. Entrepreneurs receive the flow a from the surviving units and pay the destruction (firing) cost η for the destroyed units. They consume all that is left after paying all the costs.

Financial Constraints. Given our assumptions about financial markets, two financial frictions can potentially play a role here. First, there is a borrowing constraint at the moment the entrepreneur invests. Second, there is another constraint when the liquidity shock arises. As we will

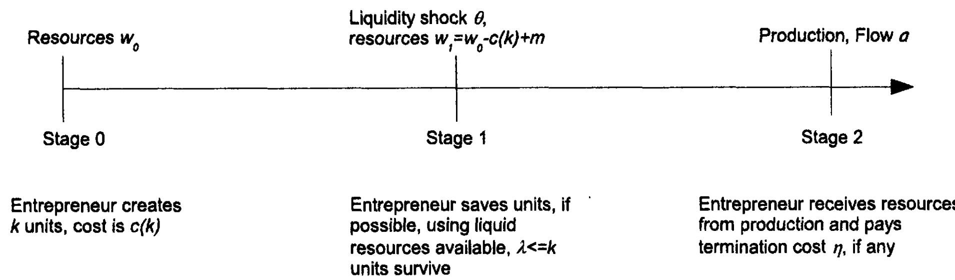

Figure 1-2. Timeline of the firm's problem.

see later on when we present the solution to the model, the borrowing constraint may not bind in stage 0, i.e. $c(k) < w_0$, but the constraint will bind with positive probability in stage 1, i.e. for some values of θ the entrepreneur will not be able to save all the units. This pattern arises because the liquidity shock creates a trade-off: more initial investment comes at the cost of lower resources for " saving" units.

Investment Decision Without Liquidity Shocks: A Benchmark

In order to qualify the effects of the liquidity shock on investment (creation) and destruction we first derive the optimal investment decisions in two alternative benchmarks: first best (no financial frictions) and a second best with a financial constraint in stage 0, but no liquidity shock in stage 1.

Lemma 1.1 *Consider the problem of an entrepreneur with access to a technology of productivity a and faces no liquidity shock. The optimal investment level with perfect access to financial markets is*

$$k^{FB}(a) = c'^{-1}(a). \tag{1.1}$$

Similarly, if the entrepreneur faces a borrowing constraint in stage 0, the optimal investment level is

$$k^{BC}(a, w_0) = \begin{cases} c^{-1}(w) & \text{if } w_0 \leq w^{FB}(a) \\ k^{FB}(a) & \text{if } w_0 > w^{FB}(a) \end{cases}, \tag{1.2}$$

where w_0 are the total resources she has available for investment at the beginning of stage 0, and

$$w^{FB}(a) \equiv c\left(k^{FB}(a)\right) = c\left(c'^{-1}(a)\right)$$

is the amount of resources needed in stage 0 *to finance the first best level of investment.*

These results are intuitive. In the first best, the entrepreneur invests up to the point where the marginal cost equals productivity, irrespective of the initial level of wealth. If the entrepreneur faces a borrowing constraint in stage 0, then for low levels of wealth she will be constrained and will invest all of her resources. Of course, if $w_0 \geq w^{FB}(a)$, the borrowing constraint no longer binds and investment equals the first best.[12]

Investment with Liquidity Shocks

We now study the problem of interest for us. Entrepreneurs are not only restricted on their capacity to borrow to invest in production units, but also have a constraint on the resources they can collect to match their liquidity need. In this case firms face a trade-off between size and ability to cope with the ex-post shock.[13]

Stage 1 problem. Consider a firm that has invested in k production units of productivity a and has $w_0 - c(k)$ dollars left. Facing a shock θ, the entrepreneur always wants to save the units she created in stage 1, the problem is whether she has enough liquidity to do so. Denote by s_0 the amount not spent on new units at stage 0 (" savings") and by w_1 the total liquid resources the entrepreneur has access to during stage 1, in short, cash-on-hand; then $s_0 = w_0 - c(k)$ and $w_1 = s_0 + m$. The extra liquid resources m are not a source of income for the entrepreneur, but they capture the access to a limited amount of liquid funds that can be used to cope with the liquidity shock, e.g. a credit line.

Given the total cash-on-hand w_1, the entrepreneur can save all her units for low enough θ; however, if $\theta > \frac{w_1}{k}$ even if she pledges all her " cash", she can save some but not all the initial production units. Denote by λ the number of units she saves, then

$$\lambda(\theta, k, w_1) \equiv \min\left\{k, \frac{w_1}{\theta}\right\}. \tag{1.3}$$

[12]If instead we assume that θ represents real costs, i.e. an stochastic need of extra materials or repairs to machinery for example, then the first best allocation and the allocation with borrowing constraints would also be functions of the distribution of θ.

[13]See Tirole (2006) for a review of related models that explore this trade-off in a setting where liquidity needs arise from run-off shocks. Also, we assume away any information problem in the management of the firm and take financial constraints as given.

Also, denote by

$$\theta^*(w_1, k) \equiv \frac{w_1}{k}, \tag{1.4}$$

the value of θ such that an entrepreneur can save all her productive units.

Consequently, for an entrepreneur who created k production units and faced a reinvestment shock θ, her total resources in period 3 will be

$$R = s_0 + (a + \eta)\lambda(\cdot) - \eta k, \tag{1.5}$$

where λ is as defined in equation (1.3).

Problem in stage 0. As the entrepreneur consumes at the end of stage 2 and is risk neutral, she will choose k to maximize her expected resources at the end of stage 2.[14] Then the period 0 problem is

$$\max_{k \geq 0} \; s_0 + \int [(a + \eta)\lambda(\theta, k, w_1) - \eta k] f(\theta)\, d\theta \tag{1.6}$$

subject to

$$w_0 \geq c(k)$$
$$s_0 = w_0 - c(k)$$
$$w_1 = s_0 + m,$$

and where $\lambda(\cdot)$ is given in equation (1.3). Denote by $\overline{k}(w_0)$ the investment level such that $c(\overline{k}) = w_0$.

The following proposition characterizes the (unique interior) solution to the entrepreneur's problem.

Proposition 1.1 *Consider the problem of an entrepreneur with initial resources w_0. There exists a function $k^*(w_0, m, a) : \mathbb{R}^+ \longrightarrow (0, \overline{k}]$ such that $k = k^*$ is the solution to problem (1.6). The function $k^*(w_0, m, a)$ is strictly positive and if $m < \widehat{m}(w_0, a)$ or $w_0 \geq w^{FB}(a)$,*

$$k^*(w_0, m, a) < k^{BC}(a, w_0) \leq k^{FB}(a),$$

i.e. the liquidity constraint depresses creation.

[14] This expression is derived in Appendix A.1.1.

If $m \geq \widehat{m}(w_0, a)$ *and* $w_0 < w^{FB}(a)$, *then* $k^*(w_0, m, a)$ *is strictly positive and*

$$k^*(w_0, m, a) = k^{BC}(a, w_0) < k^{FB}(a),$$

i.e. creation is not depressed further by the liquidity risk.

In words, proposition 1.1 states that for any level of wealth, the absence of full insurance against the liquidity needs leads to a reduction in creation, and this effect is beyond the constraint on initial investment, indeed the entrepreneur may or may not hit the borrowing constraint in stage 0 depending on the *relative liquidity availability* in stages 0 and 1. Although risk neutral, the entrepreneur will self-insure by holding liquid assets (a precautionary motive for holding liquidity), with this demand arising because of the incomplete markets assumption. Even with the liquid asset holdings, the entrepreneur will not be able to always save her units, a consequence of the assumption that the distribution of θ is unbounded from above.[15]

Notice that the results in lemma and proposition 1.1 imply that the optimal creation decision is independent of the distribution of the shock unless there are incomplete markets and firms have an incentive to save part of their wealth. In that case, which is the one we are interested in, liquid assets have some value if stored and hence the firm faces a portfolio decision. The trade-off arises here: balancing the attractive investment in units vis-a-vis the decision to save liquid (but expensive) assets to cope with the bad time had they come.[16]

Destruction

Before deriving the comparative statics, we need to find an expression for destruction by firms in our economy. Following the same reasoning we used to derive the formula for revenue, we can compute destruction as

$$D(k, w_1) = \int_{\theta^*}^{\infty} \left[k - \frac{w_1}{\theta}\right] f(\theta)\, d\theta. \tag{1.7}$$

[15]If we assume that the distribution of θ can only take values up to $\overline{\theta} < \infty$, then we can show that entrepreneurs with a wealth level larger or equal than

$$w_0^{self}(a) = \max\left\{c\left(k^{FB}(a)\right) + k^{FB}(a) * \overline{\theta} - m, 0\right\}.$$

will not be restricted in their investment by the liquidity shock.

Our main conclusions remain true in this case, and we choose to present a simpler model to highlight the main results.

[16]It is worth noting that if we assume the shock is a stochastic real cost and not just a liquidity need the results are qualitatively the same, but we would get some extra effects according to productivity of the firms; given we do not observe productivity in our sample we present here a simpler version.

However, we already showed that firms will adjust their sizes at the moment of creation, hence we need to obtain an expression that incorporates this effect. We derive such expression by plugging $k^*(a, w_0, m)$ into equation (1.7) to obtain,

$$\widehat{D}(w_0, m) = \int_0^\infty [k^*(\cdot) - \lambda(k^*(\cdot), \theta, w_1)] f(\theta)\, d\theta = \int_{\widehat{\theta}}^\infty \left[k^*(\cdot) - \frac{w_1^*}{\theta}\right] f(\theta)\, d\theta, \tag{1.8}$$

where

$$\widehat{\theta}(w_0, m) \equiv \theta^*(w_0, m, k^*(\cdot)), \tag{1.9}$$

and

$$w_1^* = w_0 - c(k^*) + m.$$

Equation (1.8) reflects the fact the firm adjusts its investment decision to changes in w_0 and m (and η). The difference between $D(k, w_1)$ and $\widehat{D}(w_0, m)$ because the timing of the flows, w_0 and m, as the margin of adjustment each firm has depends on the particular stage of the process at which the resources become available.

Our first result implies that ex-ante firms expect some destruction with positive probability, implying that they will never be willing (and able) to completely self-insure against the liquidity shocks.

Remark 1.1 *Firms never fully insure against the liquidity shock, i.e. there will always be a strictly positive probability of some units being destroyed.*

Comparative Statics

We can now characterize the comparative statics with respect to two variables of interest, w_0 and η. As we just mentioned the timing of the shock (or the news about the shock) matters when determining the margins of adjustment of the entrepreneur. Thus, for destruction we present results that consider the solution to the problem in stage 0, i.e. including the creation decision, and also at stage 1, i.e. when the investment decision is sunk and the firm can only adjust the destruction margin.

Proposition 1.2 (Comparative Statics) *In problem (1.6), creation k^* is increasing in wealth w_0 for any w_0, a and m, i.e.*

$$\frac{\partial k^*}{\partial w_0} > 0, \qquad \forall\ w_0, a, m > 0,$$

decreasing in the destruction cost η,

$$\frac{\partial k^*}{\partial \eta} \leq 0,$$

and increasing on liquid funds in stage 1,

$$\frac{\partial k^*}{\partial m} \geq 0$$

The effect of w_0 *and* m *on destruction is ambiguous, i.e.*

$$\frac{\partial \widehat{D}}{\partial w_0} \gtreqless 0, \qquad \frac{\partial \widehat{D}}{\partial m} \gtreqless 0.$$

An increase of the destruction cost η *reduces destruction,*

$$\frac{\partial \widehat{D}}{\partial \eta} < 0.$$

Creation being an increasing function of available financial resources, w_0, is not surprising. If the entrepreneur receives some more resources, she will then choose to keep some aside and to invest the rest in new units. The same is true for the case of m, as an increase in liquidity in stage 1 allows her to save more units, thus she can increase investment reducing her self-insurance s_0.

The result that creation is decreasing on η comes from the fact that a large η makes destruction more expensive, reducing the expected return of a unit for a given amount of liquid wealth (and a given probability of destruction), hence making investment less attractive. Also, reducing creation frees resources to cope with the liquidity needs in stage 1, hence reducing the probability that a unit will be destroyed ex-post, thus helping to counteract the effect on the expected profitability of the units.

An important part of the effects of w_0, m and η on destruction comes from the fact that firms will adjust their sizes in response to the change in available resources, as we have already seen for the comparative statics of creation. This mechanism turns out to be important, particularly for the case of the firing costs. Keeping this observation in mind, the results for destruction are intuitive. An entrepreneur who faces a decrease in the total resources available before investing will adjust the size of the plant through a reduction in the number of units created, and save some resources for the liquidity shock stage; this reaction implies two extra elements: first, there are fewer units to be destroyed; and, second, the reduction in investment leaves more resources available.[17]

[17]It is possible to show that " savings" $w_0 - c(k^*)$ is an non-decreasing function of w_0.

Similarly, an increase in the firing cost η has no effect on destruction after the investment decision has been made. But at the same time, the effect on destruction for a firm that can adjust investment is negative, faced with a more expensive liquidation the firm adjusts size, lowering the number of units, reducing then the money needed to cope with the liquidity shock, but also freeing some resources because less is spent on creating the units.[18]

Lemma 1.2 (Unexpected Liquidity Shock) *An unexpected shock that reduces m in stage 1 increases destruction, i.e.*

$$\frac{\partial D(\cdot)}{\partial m} = \left.\frac{\partial \widehat{D}(\cdot)}{\partial m}\right|_{k,s_0} < 0.$$

If the entrepreneur faces the (unexpected) decrease in m after the investment decision was made, the only effect comes from the lower resources that can be committed in stage 1, thus for each possible realization of θ, fewer units will be

Discussion

Linking to Sudden Stops. In order to study the effects of sudden stops we link them to available resources w_0 and m.[19] In the context of our simple model we interpret a sudden stop as a contraction in financial resources available to entrepreneurs, and hence we can study its effects by looking at the effects of a reduction in w_0 and/or m.[20]

Our empirical strategy tries to link responses to sudden stops with exposure to financial conditions. Let us think for a moment that each plant p in sector i in has access to resources

$$w_{0ip} = \omega_i G + \varepsilon_{ip},$$

[18]Notice that with a pure liquidity shock, all entrepreneurs want to save as many units as they can irrespective of the productivity levels. One simple way to change that is to assume that at least part of the θ shock comes in the form of run-off costs. That way part of the cost actually represent payments that must be made; consequently high shocks may induce entrepreneurs to save the money instead of paying the cost. For example, if the all the shock is a real cost, then a unit will be destroyed for sure if

$$a + \eta - \theta < 0.$$

[19]Alternatively we can define a sudden stop as a shock that shifts the distribution of θ, in the sense that when in a sudden stop the distribution first order stochastically dominates the distribution in normal times. In this case, the effects of a sudden stop are qualitatively similar, and hence we chose our definition as we consider it simpler to derive and present.

[20]Notice that we are calling a productivity, but it can also be identified as a " demand" parameter, and hence we could assume that sudden stops also affect it. There are many possible channels, e.g. imports, general equilibrium effect on consumption coming from the credit crunch, relative prices, etc.

and

$$m_{ip} = \chi_i G + \zeta_{ip}.$$

Where G is an indicator of aggregate conditions in the financial markets. A sudden stop reduces the availability of funds in the market, hence $\partial G/\partial SS < 0$. Then the coefficients ω_i and χ_i, represent a sector-wide sensitivity to financial conditions. Using the results in proposition 1.2 and lemma 1.2, this implies that the effect of sudden stops is larger for sectors with larger ω_i and/or χ_i. Our variables for financial characteristics should then be interpreted as proxies for the ranking of sectors according to ω_i and χ_i.[21]

In addition, in reality the economy is comprised of firms that are in different stages of the production process, hence when the shock arrives (or news about a shock are received) some of them will have already invested while some will be making their decision with respect to size. Notice also another implication of our model: even if a firm does not receive a direct shock from the sudden stop, anticipating a reduction in resources in the future leads to adjustments in the creation margin (the effect of m on k^*).

Extensions. Our model also shows that other variables can affect the investment decision. Some of those variables are likely to be affected by the occurrence of a sudden stop. Consider for example the flow a. In the context of an open economy this variable can respond to demand conditions (e.g. cyclical variations) and prices (e.g. real exchange rate). Both may change during sudden stops. In our empirical analysis we perform robustness checks, using variables that can capture these other channels for sudden stops as controls. As we explain in more detail later we observe that although these channels play a role, they do not eliminate the direct effect of sudden stops on gross flows and the role of sectoral financial characteristics.

The model we present here highlights the trade-off between size and liquidity for a *new* entrepreneur facing convex costs of creation. We can relax the latter introducing a small fixed cost of creation, which induces some range of inaction but conditional on entering the entrepreneur still faces the same type of trade-off: size vs. liquidity. We can also think of an existing plant as an entrepreneur that has some initial units at the beginning of period 0; if these units are also subject to the liquidity shock, we face a similar situation with the difference that the entrepreneur may

[21] In Appendix A.1 we present a variation of the model that allow firms to obtain part of the revenue before they face the idiosyncratic shock θ. This alternative model gives one potential reason why some sectors may experience larger effects of sudden stops on their availability of funds at stage 1.

choose not to create new units in order to improve her " liquidity" position for stage 1.[22]

1.3.2 Summary

Motivated by the previous model and the literature reviewed in section 1.2 we proceed to study the case of sudden stops in Latin America. In particular, we look for evidence on the following hypotheses:

1. Firms in sectors depending more on external finance should be more affected during sudden stops. Thus, creation will be lower in these sectors. The effect on destruction is ambiguous as plants can adjust their sizes.

2. Firms in sectors more exposed to liquidity needs are likely to destroy more, particularly so during a sudden stop. This effect is stronger when they cannot adjust their size by changing the creation decision.

As our model also suggests that destruction costs do affect creation decisions, we also introduce labor market regulations that affect the cost of firing a worker, as a proxy for the cost of destroying a unit. We also use our data on job flows from continuing versus all plants as the financial position of firms may be affected by previous borrowing or better information (through previous financial operations), if new plants are a significant fraction of the difference, for example. Another reason why the response measured on series for all and continuing plants can differ has to do with the role of pre-existing units: we can think about continuing plants as units that start at stage 0 with some number of units k_0, then continuing plants have an extra incentive to save liquid resources for stage 1.

In the next sections we seek for evidence along these lines using data on gross job flows in Latin America, over a sample period where these countries suffered significant sudden stops.

1.4 Data and empirical approach

1.4.1 Empirical Strategy

We estimate the following equation:

$$y_{ijt} = \alpha S_{jt} + \beta x_{jt} + \delta m_j S_{jt} + \rho z_i S_{jt} + \mu + \varepsilon_{ijt}, \tag{1.10}$$

[22]Notice that if the existing units do not suffer the liquidity shock and give some fresh resources they may actually help improving the ability to cope with liquidity needs.

where y_{ijt} is some measure of job flows (creation, destruction) in sector i, country j, and time t, S is a measure of external shocks to financial conditions –sudden stops in this chapter–, x_{jt} is a vector of institutional characteristics and controls that varies at the time and country level, m_j is a vector of country specific institutional variables (e.g. labor market regulation), z_i is a vector of sector specific characteristics (e.g. financial dependence), and μ is a vector of dummy variables and fixed effects. All our regressions include country, year and sector fixed effects, and some specifications also include interactions of (any two) of them; all sector and country variables are included as deviations with respect to their sample means.[23]

The interaction effects ($z_i S_{jt}$ and $m_j S_{jt}$) are the most important part in this regression. The sector specific characteristics are related mainly to financial characteristics of the sectors, and we will follow the existing literature assuming that at least part of the observed differences across sectors in financial outcomes is associated with technological differences. Labor market regulation is a usual suspect in many cases, this case being no exception; theoretical work shows that there are potential connections in this situation, and our work shows empirical correlations along these lines. The α coefficients reflect estimates of the effects of sudden stops on an average country, and hence gives an estimate of the baseline effect of the sudden stops on labor flows.

As has been noted before, our main analysis restricts the sample of countries to Brazil, Chile, Colombia and Mexico. There are two different reasons to drop Argentina and Uruguay. First, we do not identify any sudden stop in Uruguay during the years for which we have labor flows data. Second, the nature of the original surveys from which data was collected in both countries differs from the rest. For both countries there is no information on new plants, as only continuing plants are observed in their sampling. This lack of data makes it impossible to compare continuing and all plants data. We also present results using all countries in Appendix A.2 and there we can observe that our main conclusions do not depend on this selection criteria.

1.4.2 Data Description

Labor Flows.

Data on sectoral gross flows comes from Haltiwanger et al. (2004). Data is at the 2-digit sector level for 6 Latin American countries from 1978 to 2001. The database was originally constructed by the IADB using firm level data from: Argentina, Brazil, Chile, Colombia, Mexico and Uruguay.

[23]Not all the regressions include the corresponding interactions.

The original surveys record flows in workers or jobs, not in hours, hence our study captures only the extensive margin on workers. The original data contained employment at the firm level and it was aggregated by sectors.[24]

Consider a given sector and country, let p index the plants and t the period, then $E_{p,t}$ represents employment in plant (firm) p at time t. Net employment growth is given by

$$Net_{p,t} = 2\left(\frac{E_{p,t} - E_{p,t-1}}{E_{p,t} + E_{p,t-1}}\right). \tag{1.11}$$

Job creation corresponds to the sum of net employment growth over all plants with positive net employment growth (for a given country-sector pair) between period $t-1$ and t,

$$Creation_t = \sum_p \phi_{p,t} \max\left(Net_{p,t}, 0\right), \tag{1.12}$$

where $\phi_{p,t}$ is employment share of plant p.

Job destruction is then the sum of the absolute value of net employment growth over all plants with negative employment growth between period $t-1$ and t,

$$Destruction_t = \sum_p \phi_{p,t} \left|\min\left(Net_{p,t}, 0\right)\right|. \tag{1.13}$$

We use data for manufacturing sectors, as it is the only data available for all countries. For each series we have two types of data, continuing and all plants.[25] Data for continuing plants includes information from those plants alive in both t and $t-1$; all plants/firms include all plants observed in t irrespective of whether they are new or not. As previously mentioned, for Argentina and Uruguay we only have data for continuing plants.[26]

Table 1.1 presents the summary statistics for the whole set of six countries and for the main group of countries in our estimation (Brazil, Chile, Colombia and Mexico). We can see that there is large variation both in creation and destruction across countries; Mexico has the highest rates of creation (in 1996), but Chile shows the highest destruction rates for all plants (in 1982) and Colombia for continuing plants (in 1992). Chile also presents the largest differences between the maximum and minimum values for creation and destruction in the sample.

[24]See Appendix A.2 for a description of the original sources.

[25]The dataset includes data on plants and firms, but for simplicity we refer only to plants.

[26]There are other differences in the data in the case of Argentina and Uruguay; we explained them in more detail in the outline of our empirical strategy in section 1.4.1.

Unfortunately, there is one dimension our dataset misses. We do not observe plant turnover data, i.e. we have no information on flows associated with closing down plants, nor the plant flows by sector. The latter dimension is important when studying the effects of financial shocks, as liquidity needs may drive firms out of the market if they cannot borrow to maintain operation. It is also relevant to observe firms that change property, either because of bankruptcy procedures or because of fire-sales when in sudden stops. Thus, although these potential channels are not studied in this chapter, our results highlight another potential channel for the transmission and propagation of sudden stops in developing countries.

Sudden Stops.

We follow recent work and identify the sudden stop episodes directly from quarterly capital flows data.[27] In particular, a sudden stop is a period that

1. Contains at least one observation where the year-on-year fall in capital flows lies at least two standard deviations below its sample mean;

2. Begins the first time the annual change in capital flows falls one standard deviation below the mean;

3. Ends once the annual change in capital flows exceeds one standard deviation below its sample mean.

Based on this definition we construct two variables. The first variable measures the fraction of quarters in which a sudden stop happened (henceforth denoted by SS). The second is a dummy variable that takes a value of 1 if there is a sudden stop in any quarter of the year. We present results using the first of the two, but the results are qualitatively the same if we use the latter variable instead.

Table 1.2 shows the years for which we identify a sudden stop together with the years for which we have job flows data for each of the six countries. We can see that we do not identify any sudden stop for Uruguay according to this definition. On the other hand, we find that Argentina has spent about half of the sample period in sudden stops. All of our sudden stop episodes have been identified before in other studies, and we believe are reasonable according to previous knowledge and work on the topic.[28] Interestingly for our identifying assumptions, with the exception of Mexico 1994-1995,

[27]See for example Calvo et al. (2006) and Gallego and Jones (2005).

[28]See Caballero and Panageas (2007) and Calvo et al. (2006). Some studies, eg. Caballero and Panageas (2007), have identified a sudden stop in early 1980s in Colombia, but according to our definition this is not the case.

all the sudden stops identified in our sample correspond to periods of bunching of sudden stops in the paper by Rothenberg and Warnock (2006), which in turn correspond to periods in which credit conditions worsen due to exogenous reasons as documented in Gallego and Jones (2005).

Sector Characteristics.

We use two types of sector characteristics; one related to financial conditions, and the other to turnover and labor reallocation.

Financial Characteristics. We use two sets of financial characteristics; one is related to the original Rajan and Zingales (1998), RZ hereafter, measure of external financing needs. The other corresponds to variables that are associated with liquidity needs, and hence refer to more immediate, or short-run, financing.

1. *External financing dependence*: The first sector level characteristic we use corresponds to the RZ measure of external financing dependence. It captures a sector's dependence on external financing by measuring the fraction of the assets that is financed with external funds. A sector with a higher RZ measure should suffer more in the event of a financial crunch or any other reduction in the access to credit. (We denote it by *Fin1*.)
   Alternatively, we also use the RZ measures from Micco and Pagés (2006) and Raddatz (2006) as a robustness check, and the results are qualitatively similar.[29] (These variables are denoted by *Fin2* and *Fin3*, respectively.)

2. *Liquidity " needs"*: Following Raddatz (2006) we use two different proxies for the liquidity needs of firms. First, the cash conversion cycle (denoted by *CCC*), which corresponds to an estimate of the length in days between the moment a firm pays for the raw materials and the moment it finally receives the payment for the sale of the final goods it produces; we use the median value across firms in a 2-digit sector. Second, we use the median value of the ratio of total inventories to sales (denoted by *Inv/Sales*) across firms in each sector.

The two sets of financial characteristics require some explanation. Given their definition, these measures capture different dimensions of the financial needs of firms. The first set, based on the initial Rajan-Zingales approach, measures dependence on the base of the use (in equilibrium) of

[29] Unlike the other measures, the one based on data from Raddatz (2006) is computed as the median across firms in each 2-digit sector. The previous two consider the mean of the same measure across sub-sectors in each 2-digit sector. Consequently, the different measures have different sensitivity to heterogeneity within each 2-digit sector.

external funds in asset acquisition, and hence it relates more to long-run and investment decisions. On the other hand, the liquidity needs measures explicitly capture financial needs arising from delays between production and sales revenue collection. This is obviously related to short-run liquidity needs and the dependence on financial markets to cope with them during the production process.

Labor Reallocation. Taken from Micco and Pagés (2006), it measures industry reallocation in US industries as the sum of job creation and job destruction as fraction of total employment. Like in the case of the RZ measure for financial exposure, the underlying assumption is that measures in the US capture technological components that are valid to rank sectors in other countries.

Labor Regulation.

Labor regulation measures are taken from Botero, Djankov, La Porta, Lopez-de Silanes and Shleifer (2004). Out of all the measures they compute we focus on the cost of firing workers and the number of procedures required to dismiss a worker; in our estimations we follow Micco and Pagés (2006) and use the sum of the two, but the results are robust to controlling separately for both measures. The cost of firing workers is a measure of how expensive it is for a firm to fire 20% of the workers; it includes all the compensations and penalties needed to pay in this case. The dismissal procedures variable counts the number of measures a firm must undertake in order to be able to dismiss a worker. The highest value of the labor regulation measure in our sample corresponds to Mexico with 1.28 out of a maximum of 2; the minimum is 0.83 in Colombia.

It is worth to keep in mind that the Botero et al.'s (2004) study compares labor regulation as of 1997 for a total of 85 countries. This is particularly relevant because some countries in our sample underwent labor market reforms during the period, thus we later consider regressions using samples restricted to the 1990s only.

1.4.3 Identification

The use of sector level data allows us to use two sources of identification. First, sector level data allows us to control for unobserved country characteristics and rely on particular sector specific (but not country-sector specific) variables to identify sector specific effects of sudden stops. Part of this effect comes from interaction effects between sector characteristics and the prevalence of sudden stops, e.g. we expect sectors that rely more on external financing or have less access to collateral to suffer more during a sudden stop than sectors with better chances of self-financing its operations (or at least part of them). The same argument follows for the liquidity related variables, as the source of identification is the same.

Second, cross country variation in labor market regulation allows us to compare sectors across countries. While not absolutely bulletproof, this identification strategy provides initial evidence on whether these variables may indeed affect the reallocation process.[30]

The identification assumption differs according to the source of variation we are exploiting. In the case of country characteristics, we need that neither intensity nor timing/frequency determinants of sudden stops are correlated with labor market regulations or their determinants. Suppose a country is pegging its nominal exchange rate, if tighter labor market regulations make the country less likely to defend against a speculative attack because the cost of the defense is higher, we would have a case where there is some reverse causality and hence our identification assumption is violated. Similarly, if labor market regulation is endogenous to the intensity and/or frequency of sudden stops, then the same problem would arise.[31]

In the case of sector level variation, the identification assumption is milder and more likely to hold. We need any determinant of the sudden stop (or its size) not to be systematically correlated with sector characteristics that determine the sensitivity of firms in each sector to the sudden stop, which in our case are financial dependence and liquidity needs (or any other sector characteristic that is correlated with any of these two characteristics). Notice that it does not require the sudden stop to be independent of country characteristics, but to be uncorrelated with determinants of the sector specific sensitivity to them. We believe this condition to be weaker than the one mentioned in the paragraph above, and also likely to hold in our sample.

Our discussion above implies that of the two sets of estimates we obtain, it is more plausible to give some structural or causal interpretation to the sector characteristics. Even if we were not able to interpret some of the coefficients as causal effects, our results are still interpretable as stylized facts about correlations between financial characteristics and the extent of the response of sectoral gross job flows to sudden stops.

The use of US-based measures has caused some controversy in the literature because of the assumption that we can extrapolate to different countries. There are two elements to consider in

[30]Our baseline regressions include also the interaction of rule of law and sudden stops as a way to capture the general institutional environment in the country.

[31]Another potential source of concern would be if contagion is selective, i.e. international investors liquidate their positions first in countries that are more likely to suffer (like in a currency attack model).

this respect. First, there is evidence that rankings based on the RZ measure of financial dependence performs well in other countries. Second, as we are interested in intrinsic (most likely technological) characteristics that make sectors differ in their financial decisions, we can think of equation (1.10) as the reduced form of an IV estimation where the US-based measure is used as an instrument for the country specific variables.

1.5 Results

1.5.1 Sudden Stops and Labor Flows

The main results for the effects of sudden stops can be observed in the top row of each panel in tables 1.3 and 1.4. Table 1.3 shows the effects on job creation, where we can see that, after controlling for labor regulation and sectorial financial exposure, sudden stops have a (weakly significant) negative effect on job creation by all firms. We can also see that the results are very similar if we compare the *all* and *continuing* plant series; this implies that the responses are not concentrated on existing plants adjusting their size, but they seem to affect other margins too. The results for job destruction are in the first row of each panel in table 1.4; there we observe that during sudden stops destruction is between 50% and 85% larger than in an average year (in the average sector and country), implying a very large effect of sudden stops on labor flows, particularly on destruction of jobs. As in the case of job creation, we can also see that the effect of sudden stops is not sensitive to the use of *all* or *continuing* plant series.

Although not surprising, these results are important, particularly because they imply that labor market flows (and potentially frictions) are relevant in any model that wants to explain the economic effects of sudden stops on a developing economy. In particular, higher destruction and depressed creation hint that at least within manufacturing the adjustment requires a change in the direction of the flows, hence the speed of the recovery will definitely be affected by the particular characteristics of the labor market.

A Detour: Labor Market Regulation. In our main specification (equation 1.10) we also include as a control the interaction between our labor market regulation measure and the sudden stop variables (δ in our regression). This coefficient reflects the variation in the response of labor flows to a sudden stop that arises from the different levels of labor market regulation. Although many theoretical models predict these type of effects, the empirical literature available has not been successful in identifying them. In our case, we do not identify the effects during tranquil times, but are able to discuss the relative magnitude of the reaction to a shock. We believe an exploration of this particular result, while interesting, is for now beyond the scope of this chapter (and of the data we have at hand).[32]

Table 1.3 present the effects on job creation. We can observe a significant negative effect on job creation by continuing firms, with a point estimate of roughly 0.1, implying that for the *average* sector, job creation would be 4.4 percentage points lower if moved from Colombia to Brazil (the minimum and maximum of labor regulation in our sample) during a year long sudden stop.[33] For the case of data for all plants, we do not find evidence of a significant effect of labor market regulation. Results for job destruction are presented in the second row of each panel in table 1.4. As expected, we find a significant negative effect of labor market regulation on job destruction during a sudden stop. For the case of continuing plants, our point estimate implies that moving from Colombia's to Brazil's labor regulation level would decrease job destruction by approximately 6 percentage points. The effect on job destruction of all plants is somewhat smaller and less significant, but it is still robust to the inclusion of sectorial controls. We perform one further exploration of the relation between firing costs and job flows during sudden stops. We use data on labor reallocation, defined as the sum of job creation and job destruction, by sectors in the US, taken from Micco and Pagés (2006), and interact it with the sudden stop variable and the labor market regulation measure. The results are in line with our previous results, but they also imply that firing costs and dismissal procedures affect the most those sectors with higher labor reallocation.[34]

1.5.2 Sectoral Effects

While the results on the average effect of sudden stops are important and highlight an aggregate pattern for the effects in manufacturing sectors, they also hide significant differences across sectors. As we mentioned before, figure 1-1 shows the sector specific response of job creation to a sudden stop. There we can see that the responses to the sudden stop differ by sector, a pattern that can also be observed in the case of job destruction, regardless of whether we use data for continuing or all plants. Previous literature and our theoretical framework suggest that financial fragility or exposure to financial market conditions are likely to affect hiring and firing decisions by firms: new

[32]As we explained before in our discussion on the sources of identification we exploit, these results must be treated with caution.

[33]Remember that our main results include a variable that measures the fraction of the year a country is in sudden stop (taking values from 0 to 1 at intervals of 0.25).

[34]Results are available upon request from the authors.

projects may be delayed, some plants/firms may reduce their scale because of financing problems, etc. Motivated by this we now turn our attention to the relation between sector specific responses of job destruction and job creation to sudden stops and financial characteristics of the sectors, dependence on external financing and liquidity needs.[35]

(Long-run) Financial Dependence

Tables 1.3, and 1.4 present the results of our benchmark estimations. The rows labeled *Fin1*SS* correspond to the interaction of the RZ measure of financial dependence by sector with the sudden stop. We can observe a clear pattern; job creation is lower during sudden stops and more so in sectors with higher financial dependence. Moreover, there is some weak evidence that new firms are more sensitive to financial dependence, as the point estimates for all plants/firms are larger in absolute value than the ones for continuing firms only. The rows labeled as *Fin2*SS* and *Fin3*SS* correspond to two alternative (more recent) measures of the Rajan-Zingales indicator; the picture that emerges from them is the same, although with smaller coefficients. In this case the difference on the effect on job creation between all and continuing plants is smaller too. It is important to mention that there are also differences in the exact way these measures deal with potential heterogeneity across subsectors, and this does not seem to affect the point estimates, suggesting we are indeed capturing a technological component in this respect.[36]

Our main results using *Fin1*SS* suggest that during a year long sudden stop, job creation in the sector with the highest financial exposure is approximately 2.7 percentage points smaller than in the sector with the smallest financial exposure, and approximately 1.6 percentage points smaller than in the average sector of our sample.[37]

(Short-run) Liquidity Needs

The results for short-run liquidity needs are in the rows labeled as *CCC*SS* (for the cash conversion cycle variable) and *(I/S)*SS* (for inventories over sales) in tables 1.3 and 1.4. The results are extremely clear and complement the results for the (long-run) financial dependence variables. We observe that while most of the coefficients are negative for job creation they are not

[35]Another margin refers to destruction of plants and the consequent separation of workers, unfortunately, as we mentioned before, we cannot study this last channel.

[36]We also tried a " pooled" specification with data from both continuing and all plants. We find the same results for the general effect of sudden stops. The relation between specific sector responses and financial characteristics is also robust to this change: investment related financial characteristics (RZ) are related to a larger decrease in creation, while sectors with higher values of the liquidity variables experience larger increases in destruction.

[37]The same numbers are 1.8 and 1.0, respectively, for continuing plants only.

statistically significant. The opposite picture arises in the case of job destruction in table 1.4, where the coefficients are positive and statistically different from 0. Notice also that although the numbers are slightly smaller for continuing firms, they are not very different from the results using the data for all firms. The results are also relevant in magnitude, for the case of continuing plants, on average the sector with the highest cash conversion cycle variable exhibits a job destruction flow 3.9 percentage points higher than the sector with the lowest value.[38] In the case of the inventories to sales ratio, the difference between the maximum and the minimum is associated with an average increase in job destruction of approximately 3.1 percentage points. These numbers represent approximately between two-fifths and one-half of the effect of a sudden stop on job creation in the average sector (using the data on continuing firms).[39] Overall, these results suggest that patterns of job flows across sectors during a sudden stop are related to the financial characteristics of the sectors.

It is important to emphasize that for both measures of financial characteristics, financial dependence and liquidity needs, the effects remain significant even if we include them together in our baseline regressions. There is one result we would like to highlight: the difference in the margins to which each financial variable is related. This dichotomy is interesting and we believe it to be reasonable, particularly in light of the mechanisms highlighted in our simple model in section 1.3; furthermore, these effects on separate margins are also robust to changes in the specification of the regressions. This is a new result in the literature on financial frictions and sector outcomes; previous results, see for example Braun and Larraín (2005), Larraín (2006), Raddatz (2006) and references therein, just show that both dimensions are correlated with volatility at the sectoral level, but do not distinguish between both margins –because of the lack of data. Analyzing two separate margins on gross flows allows us to depict a slightly more detailed picture of the mechanics behind some of this correlations; we believe this to be evidence that there is indeed a connection to both aspects of finance, as suggested by our simple model, and that we are not capturing a more general idea of financial constraints. From the point of view of the effects of sudden stops, the point estimates also suggest that financial characteristics play a role in net job flows and total reallocation, defined as the sum of creation and destruction for a sector, during a sudden stops.[40]

[38]The maximum value, after removing the sample mean is 0.416, and the minimum is −0.495; hence the difference is approximately 0.9. Multiplying this number for the estimated coefficient for *CCC*SS* gives the number in the text.

[39]The minimum value of *(I/S)*SS*, after removing the sample mean is −0.053, and the maximum is 0.057; hence the difference is approximately 0.11. The effect in the text is the product of the estimated coefficient (0.285) and the difference we just mentioned.

[40]These results are confirmed with regressions using net and total flows for a sector as left-hand side variable. However, results in these cases are slightly less robust to the inclusion of both financial variables together, but in no case are signs overturned nor the magnitudes themselves are affected.

A " Back of the Envelope" Calculation. In the above sections we have presented evidence that sector specific responses are related to financial characteristics of the sectors. However, we would like to give a sense of how important is the aggregate effect on job flows that is attributable to these sector differences. Given that our identification relies on variation within a country, we can answer this using a counterfactual exercise.

Consider a particular country, at a certain moment in time, each sector represents a particular share of manufacturing employment and has its particular measures of financial characteristics. Let us then construct another economy with the same shares of employment for each sector, but where all sectors have financial characteristics equal to the minimum value observed in the sample. Using the coefficients from tables 1.3 and 1.4 and the sectoral employment shares for the case of Chile, we estimate that the effect of a sudden stop on job destruction would be between 1.73, for continuing plants, and 2.02, for all plants, percentage points lower in this economy as compared to one with the same employment shares but the original measures of financial dependence.[41] These effects represent approximately between 17% and 23% of the average destruction rate for Chile in our sample.

We can also compute the effect on job creation using the same counterfactual economy. In this case the numbers are smaller. Job creation would be slightly larger in our counterfactual economy, 1 and 0.3 percentage points higher for all and continuing plants respectively; the effects are between 8% and 4% percent of average job creation in the sample for Chile.

Real Exchange Rate Channel

In many cases sudden stops are accompanied by abrupt changes in relative prices, particularly in the real exchange rate. Consequently our sudden stop variable may be capturing, partially at least, the effect of real exchange rate changes during the periods of current account reversals. We thus add the real exchange rate (in different specifications) to our baseline regression, and we estimate

$$y_{ijt} = \alpha S_{jt} + \beta x_{jt} + \delta m_j S_{jt} + \rho z_i S_{jt} + \pi RER_{jt} + \mu + \varepsilon_{ijt}, \tag{1.14}$$

where all variables are as defined in section 1.4.1, and RER_{jt} is a measure of the real exchange rate. The results are presented in table 1.5. We can see that both for creation and destruction our results on the sectoral financial characteristics are robust to the inclusion of real exchange rates, both in

[41] We take the shares of employment to be equal to the average in Chile between 1992 and 1997, right before the sudden stop suffered after the Asian crises.

levels and changes. The point estimates do not change significantly and they remain significant.

The results for the real exchange rate present also some interesting facts. The estimated values of π imply that a more depreciated real exchange rate (a higher measured real exchange rate according to our definition) is associated with higher job creation and lower job destruction; this result is not surprising as the sectors included in our sample can be safely considered tradable sectors. This also implies that if a depreciated real exchange rate accompanies a sudden stop it may help counteract the effects on job flows.

Even within manufacturing we may expect to have that different sectors might have different sensitivity to real exchange rate variation. In particular we estimate

$$y_{ijt} = \alpha S_{jt} + \beta x_{jt} + \delta m_j S_{jt} + \rho z_i S_{jt} + \widetilde{\pi}_i RER_{jt} + \mu + \varepsilon_{ijt}, \tag{1.15}$$

where $\widetilde{\pi}_i$ is a sector specific sensitivity to the real exchange and the rest of the variables are as in equation (1.14). First of all we can see in table 1.5, columns 5-8 that the results on finance and sectoral responses, the vector ρ, are robust to sector-specific responses to real exchange rates. This specification also allows to estimate the sector specific responses $\widetilde{\pi}_i$; our results indicate a positive and significant effect of the real exchange rate but the point estimates are different in magnitude for each sector.[42]

1.5.3 Robustness Checks

In order to check the robustness of our results we perform two different tests. First, we reestimate our main equations with a restricted sample that considers data only after 1990. Additionally we perform a second check, and estimate the main equations using country-time fixed effects in addition to the interaction of financial dependence and sudden stop variables.

Restricted Sample: 1990-2000. There are two main reasons why restricting the sample in the regressions could potentially lead to changes in the results. First, given the unbalanced panel data, we repeat our benchmark regressions using data only from the 1990s. Chile is usually identified as having done reforms earlier than the rest of the Latin America. In our sample it also is the only country for which we identify a sudden stop in the 1980s. Consequently we eliminate the series of

[42] If we use the changes in the real exchange instead of the level we observe that a real exchange rate depreciation is associated with lower creation and higher destruction. However, in this case the effects are not robust to allowing for heterogeneity across sectors and are not significant in most of the specifications. More importantly for us, the results on financial characteristics are robust to the inclusion of the changes in the exchange rate.

data available for the 1980s from Chile and Colombia. This reduces our sample to 296 observations and we lose the debt crisis observations for Chile. Hence, this sample change reduces the weight of Chile and Colombia in our estimates, yielding a more homogeneous set of observations.

Second, our labor regulation and financial dependence variables are both measured in the 1990s, hence restricting the sample also allows us to avoid problems arising from changes in both measures coming from labor or financial market reforms.

The results using the restricted sample with observations after 1990 are in Tables 1.6 (creation) and 1.7 (destruction). Qualitatively the picture remains similar to our results with the full sample. Sudden stops are also periods in which we find significant increases in job destruction across the board, with relatively similar magnitudes too.

Evidence for financial dependence at the sector level is also similar to the results in our regressions using the full dataset. Higher financial dependence is correlated with lower creation during sudden stops, with point estimates of similar magnitude to the ones before. We also observe some evidence of more sensitivity by new firms in the samples. Although all coefficients are positive, we do not find significative effects of financial dependence on destruction, which confirms the same qualitative results we described in section 1.5.2.

The results on liquidity needs show a slightly different pattern. The effect on continuing firms is robust to the sample change, confirming the positive correlation between liquidity needs and job destruction. On the other side, the effects on all firms lose some significance and the point estimates are somewhat different, but still with the same sign, implying a positive but not very significant correlation between job destruction and liquidity needs. Given the robustness of the estimates for continuing firms, the main reason must be connected to new firms.

Regarding labor market regulation, we observe a negative effect on job destruction, with an effect on destruction on all firms that is more than twice as large as before (and more significant too), while for continuing plants, the effect is of the same magnitude.

Time-Country Fixed Effects Regression. Given that not all sudden stops are equal, we may be concerned that the aggregate responses at the country level might differ–either because the country itself is more sensible to sudden stops or because sudden stops are different across countries and time. For example, exchange rate policy responses may vary and hence not all the resulting changes need to be the same. If different firms respond more to financial aspects (because of currency or maturity mismatch), then the exact mix of outflow and other aggregate effects of the sudden stop may matter.[43]

To address this issue, at least in part, we reestimate the regressions with the full set of country-time fixed effects. This specification captures any time varying variable at the country level, but it does not control for interactions of these variables and sector specific effects, as we did before in the case of real exchange rates. The results are presented in Tables 1.8 and 1.9, where we observe that our previous estimations of the effect of sectorial exposure remain robust to the inclusion of country-time fixed effects. Furthermore, the point estimates do not change much when compared to those in our benchmark specifications in tables 1.3 to 1.4, and hence the interpretation of the effects remains the same.

We also ran this specification with the restricted sample from the 1990s only. As we explained before, this leads to a significant reduction on the sample size, and so the standard errors are likely to increase in this specification. Leaving aside this consideration, the coefficients on the sectoral financial characteristics are not sensitive to the inclusion of the country-time fixed effects. The point estimates are remarkably similar to the ones in tables 1.6 and 1.7.[44] All in all, these additional regressions confirm that at least the correlations between sector characteristics and the responses to sudden stops, as measured by gross job flows, are indeed robust to country-time aggregates omitted in the main specifications.

Additionally, and consistent with the concern that our sudden stop interactions could be capturing some interaction between country and sector characteristics, we also run the regressions with additional controls. First, we use time-sector fixed effects, and obtain point estimates and standard errors of the same magnitude as in the baseline regressions. Second, we control for both time-country and time-sector fixed effects, and if anything our results appear to be stronger than in the baseline specifications, although the differences are not particularly large.

1.6 Conclusions and Future Research

This chapter studies the effects of sudden stops on job creation and destruction in a sample of Latin American countries, as captured by a measure of gross job flows at the sector level.

We find consistent evidence that sudden stops are associated with decreased job creation and increased job destruction. Importantly, we also observe the effects of the sudden stops on job

[43]Financial conditions are not the only ones. As previously discussed, sudden stops may also affect domestic demand conditions, hence affecting all sectors through a demand component.

[44]Detailed results are available upon request from the authors.

creation to be heterogeneous and that this heterogeneity is related to financial characteristics of the sector: job creation tends to react more to sudden stops in sectors with strong dependence on external finance. Similarly, the increasing effect of sudden stops on job destruction is also related to financial characteristics of the sector but of a different nature: the response of job destruction is larger in sectors with higher liquidity needs. A back of the envelope calculation suggests that the total effect of financial variables is not negligible.

Studying the connection between reallocation and restructuring, and financial characteristics in response to sudden stops moves us forward in two different, but related, areas. First, and central to the main interest of this chapter, it provides us with a novel look at the mechanics of sudden stops within countries. Since differences in the creation and destruction flows can affect the speed of adjustment and recovery during and after shocks, our results also signal the relevance of further studying the dynamics of the flows in the labor markets before, during and after a sudden stop. This chapter also provides some prima facie evidence that restructuring, as evidenced by gross job flows, is indeed a possible reason why responses may differ across countries and across sudden stops. Moreover, to the extent that the responses of different sectors are correlated with financial characteristics, the empirical results also suggest that we should incorporate financial market frictions into our study of the effects of sudden stops and why these differ across countries. The results on the relation between external financial dependence (RZ type of measures), liquidity needs (e.g. cash conversion cycle), and the response of gross job flows to a country level shock, a sudden stop in this case, also complement previous studies on the relation between financial frictions and sectoral outcomes, in particular with respect to the effects on volatility and sensitivity to shocks.

Finally, as sudden stops constitute large financial shocks for a country as a whole, we also contribute to the literature on job flows, reallocation/restructuring, and financial conditions by presenting additional evidence from this " extreme" shock in emerging economies, which complements the existing evidence drawn from the effects of recession and business cycles in developed economies. The relation between sectoral financial characteristics, sector responses to sudden stops and the financial nature of the shock lends support to the idea that financial conditions do matter for the process of restructuring. Moreover, these results are qualitatively relevant for other situations and relate to the existing evidence on the microeconomic responses to macroeconomic shocks, particularly about the different responses of job creation and destruction.

Future Research. Although the results in this chapter do not have a direct mapping into welfare implications, they do motivate different areas of research within the study of sudden stops. A potential way to proceed is to embed some of the results from this chapter into a multi-sector open economy model. Such a model allows us to evaluate the overall impact of a sudden stop on sectoral reallocation and gross job flows. In particular, evaluating the effects sectoral reallocation and job market flows can have on aggregate variables –such as employment, unemployment, measured productivity and wages, and the dynamics of the recovery in general equilibrium– will help us answer how important this channel can be when understanding the responses of countries to sudden stops. Finally, calibrating a model of this type provides some guidance about optimality of responses and can allow us to put the estimated effects in terms of welfare and efficiency measures.

While assessing the aggregate magnitudes and the importance of the channel at a sector level is an important first step, we can also explore within sector effects that are also relevant. For example, the use of a richer dataset in plant level information would allow us to explore more precise patterns of reallocation within and across sectors. A wealth of data in this dimension can also allow us to explore the dynamics of the response to the shocks, productivity and firm size for example, and the extent to which financial characteristics and financial frictions can affect the reallocation flows. In this same direction, it would be interesting to see what margins are affected the most during the recovery phase, as there is evidence that depressed creation seems to be the main reason why recoveries differ, as suggested by Caballero (2007) and others. Unveiling firm patterns within sectors will further contribute to understanding of the effects of sudden stops, and it may also help uncover specific microeconomic channels that explain the patterns and relations we observed in our study of the effects at the sector level.

Table 1.1. Descriptive Statistics: Job Creation and Destruction, main countries. Numbers in parenthesis are years included in the data.

			Brazil (1992-2000)			
Variable	Type	Obs	Mean	Std. Dev.	Min	Max
Creation	Cont	72	0.088	0.024	0.044	0.147
Creation	All	72	0.158	0.035	0.085	0.245
Destruction	Cont	72	0.108	0.026	0.056	0.183
Destruction	All	72	0.164	0.032	0.104	0.263
			Chile (1980-99)			
Variable	Type	Obs	Mean	Std. Dev.	Min	Max
Creation	Cont	160	0.082	0.041	0.006	0.213
Creation	All	160	0.119	0.055	0.010	0.267
Destruction	Cont	160	0.074	0.046	0.005	0.294
Destruction	All	160	0.119	0.070	0.005	0.370
			Colombia (1977-91; 1993-9)			
Variable	Type	Obs	Mean	Std. Dev.	Min	Max
Creation	Cont	189	0.067	0.026	0.011	0.135
Creation	All	189	0.095	0.034	0.025	0.197
Destruction	Cont	189	0.105	0.043	0.029	0.316
Destruction	All	189	0.103	0.042	0.029	0.310
			Mexico (1994-2000)			
Variable	Type	Obs	Mean	Std. Dev.	Min	Max
Creation	Cont	63	0.126	0.041	0.064	0.254
Creation	All	63	0.174	0.055	0.098	0.310
Destruction	Cont	63	0.078	0.029	0.035	0.171
Destruction	All	63	0.105	0.041	0.047	0.232
			Main Countries			
Variable	Type	Obs	Mean	Std. Dev.	Min	Max
Creation	Cont	484	0.083	0.038	0.006	0.254
Creation	All	484	0.123	0.053	0.010	0.310
Destruction	Cont	484	0.092	0.043	0.005	0.316
Destruction	All	484	0.118	0.055	0.005	0.370
			All Countries: Main Countries plus Argentina and Uruguay			
Variable	Type	Obs	Mean	Std. Dev.	Min	Max
Creation	Cont	646	0.075	0.038	0.006	0.254
Destruction	Cont	646	0.091	0.041	0.005	0.316

Table 1.2. Sample Coverage and Years in Sudden Stop.

Country	Sample	Year in SS
Brazil	1992-2000	1997-9
Chile	1980-1999	1981-4, 1998-9
Colombia	1978-1991, 1993-1999	1998-9
Mexico	1994-2000	1994-5
Argentina	1991-2001	1994-5, 1998-2001
Uruguay	1989-1995	None

Source: Authors' calculations.
For a detailed description of the definition of a sudden stop see section 1.4.2.

Table 1.3. Job Creation, main countries. Dependent variable is *Creation* for all and continuing plants, as written on each panel. All explanatory variables, except SS, are expressed as deviations with respect to their sample means. Country, time and sector fixed effects are included, we also control for Rule of law.

Panel (a). All Plants

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
SS	-0.03	-0.031	-0.031	-0.025	-0.031	-0.031	-0.031
	[0.017]*	[0.016]*	[0.017]*	[0.017]	[0.016]*	[0.017]*	[0.016]*
Labor*SS	0.042	0.045	0.044	0.044	0.045	0.044	0.044
	[0.063]	[0.064]	[0.065]	[0.063]	[0.063]	[0.064]	[0.064]
Fin1*SS		-0.093					-0.099
		[0.038]**					[0.053]*
CCC*SS			-0.024				0.004
			[0.017]				[0.023]
Fin3*SS				-0.055			
				[0.019]***			
Fin2*SS					-0.055		
					[0.020]***		
(I/S)*SS						-0.117	
						[0.133]	
N. Obs.	484	484	484	484	484	484	484
R-squared	0.62	0.63	0.62	0.63	0.63	0.62	0.63

Panel (b). Continuing Plants

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
SS	0.009	0.008	0.008	0.012	0.008	0.009	0.008
	[0.012]	[0.012]	[0.012]	[0.012]	[0.012]	[0.012]	[0.012]
Labor*SS	-0.099	-0.097	-0.098	-0.097	-0.097	-0.099	-0.098
	[0.047]**	[0.048]**	[0.048]**	[0.048]**	[0.048]**	[0.047]**	[0.048]**
Fin1*SS		-0.057					-0.077
		[0.028]**					[0.039]**
CCC*SS			-0.008				0.014
			[0.013]				[0.017]
Fin3*SS				-0.04			
				[0.015]***			
Fin2*SS					-0.04		
					[0.015]***		
(I/S)*SS						0.012	
						[0.099]	
N. Obs	484	484	484	484	484	484	484
R-squared	0.56	0.56	0.56	0.56	0.56	0.56	0.56

Robust standard errors in brackets.
* significant at 10%, ** significant at 5%, *** significant at 1%

Table 1.4. Job Destruction, main countries. Dependent variable is *Destruction* for all and continuing plants, as written on each panel. All explanatory variables, except SS, are expressed as deviations with respect to their sample means. Country, time and sector fixed effects are included, we also control for Rule of law.

Panel (a). All Plants							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
SS	0.087	0.088	0.089	0.083	0.088	0.089	0.089
	[0.020]***	[0.019]***	[0.019]***	[0.020]***	[0.019]***	[0.019]***	[0.019]***
Labor*SS	-0.116	-0.119	-0.121	-0.118	-0.118	-0.12	-0.121
	[0.064]*	[0.064]*	[0.063]*	[0.064]*	[0.064]*	[0.063]*	[0.063]*
Fin1*SS		0.082					0.013
		[0.050]					[0.072]
CCC*SS			0.051				0.047
			[0.019]***				[0.029]*
Fin3*SS				0.042			
				[0.024]*			
Fin2*SS					0.026		
					[0.026]		
(I/S)*SS						0.325	
						[0.144]**	
N. Obs	484	484	484	484	484	484	484
R-squared	0.62	0.62	0.62	0.62	0.62	0.62	0.62

Panel (b). Continuing Plants							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
SS	0.087	0.087	0.088	0.083	0.087	0.088	0.088
	[0.018]***	[0.017]***	[0.017]***	[0.018]***	[0.018]***	[0.017]***	[0.017]***
Labor*SS	-0.15	-0.152	-0.154	-0.152	-0.151	-0.154	-0.154
	[0.054]***	[0.054]***	[0.054]***	[0.054]***	[0.054]***	[0.054]***	[0.054]***
Fin1*SS		0.056					-0.012
		[0.045]					[0.060]
CCC*SS			0.043				0.047
			[0.016]***				[0.023]**
Fin3*SS				0.037			
				[0.023]			
Fin2*SS					0.026		
					[0.023]		
(I/S)*SS						0.285	
						[0.121]**	
N. Obs	484	484	484	484	484	484	484
R-squared	0.61	0.61	0.62	0.61	0.61	0.62	0.62

Robust standard errors in brackets.
* significant at 10%, ** significant at 5%, *** significant at 1%

Table 1.5. Real Exchange Rates, Financial Variables, and Job Destruction and Creation, Main Countries. Dependent variables as indicated on headers of panels. Estimates correspond to the specifications on equations (1.14) and (1.15), see section 1.5.2. All explanatory variables, except SS, are expressed as deviations with respect to their sample means. All regressions include time, country and sector fixed effects. We also control for labor market regulation and rule of law.

Panel (a). Destruction.

	All Plants		Continuing Plants		All Plants		Continuing Plants	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
SS	0.094	0.095	0.093	0.094	0.095	0.096	0.095	0.096
	[0.019]***	[0.018]***	[0.017]***	[0.017]***	[0.018]***	[0.018]***	[0.017]***	[0.017]***
$Finl * SS$	0.085		0.06		0.086		0.055	
	[0.050]*		[0.044]		[0.050]*		[0.045]	
$CCC * SS$		0.052		0.044		0.047		0.04
		[0.018]***		[0.016]***		[0.019]**		[0.016]**
$\ln(RER)$	-0.056	-0.056	-0.054	-0.054				
	[0.020]***	[0.020]***	[0.014]***	[0.014]***				
$\ln(RER)$ $*Sector$	No	No	No	No	Yes	Yes	Yes	Yes
N. Obs.	466	466	466	466	466	466	466	466
R-squared	0.62	0.62	0.63	0.63	0.64	0.64	0.64	0.64

Panel (b). Creation.

	All Plants		Continuing Plants		All Plants		Continuing Plants	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
SS	-0.041	-0.041	0.001	0.002	-0.04	-0.04	0.002	0.002
	[0.015]***	[0.016]***	[0.011]	[0.011]	[0.015]**	[0.016]**	[0.011]	[0.012]
$Finl * SS$	-0.092		-0.056		-0.097		-0.057	
	[0.038]**		[0.028]**		[0.038]**		[0.028]**	
$CCC * SS$		-0.026		-0.01		-0.031		-0.012
		[0.017]		[0.013]		[0.016]*		[0.013]
$\ln(RER)$	0.086	0.086	0.06	0.06				
	[0.018]***	[0.018]***	[0.014]***	[0.014]***				
$\ln(RER)$ $*Sector$	No	No	No	No	Yes	Yes	Yes	Yes
N. Obs.	466	466	466	466	466	466	466	466
R-squared	0.64	0.64	0.58	0.58	0.65	0.65	0.58	0.58

Robust standard errors in brackets.
* significant at 10%, ** significant at 5%, *** significant at 1%

Table 1.6. Job Creation, main countries 1990-2000. Dependent variable is *Creation* for all and continuing plants, as written on each panel. All explanatory variables, except SS, are expressed as deviations with respect to their sample means. Country, time and sector fixed effects are included, we also control for Rule of law.

				Panel (a). All plants.			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
SS	0.007	0.006	0.006	0.012	0.006	0.006	0.006
	[0.034]	[0.034]	[0.034]	[0.034]	[0.034]	[0.034]	[0.034]
Labor*SS	-0.074	-0.071	-0.071	-0.071	-0.071	-0.072	-0.071
	[0.110]	[0.111]	[0.110]	[0.111]	[0.110]	[0.110]	[0.111]
Fin1*SS		-0.093					-0.103
		[0.045]**					[0.059]*
CCC*SS			-0.023				0.006
			[0.022]				[0.028]
Fin3*SS				-0.058			
				[0.024]**			
Fin2*SS					-0.055		
					[0.025]**		
(I/S)*SS						-0.137	
						[0.164]	
N. Obs	296	296	296	296	296	296	296
R-squared	0.61	0.61	0.61	0.62	0.61	0.61	0.61
				Panel (b). Continuing plants.			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
SS	0.028	0.028	0.028	0.032	0.028	0.028	0.028
	[0.024]	[0.024]	[0.024]	[0.024]	[0.024]	[0.024]	[0.024]
Labor*SS	-0.163	-0.161	-0.162	-0.161	-0.161	-0.163	-0.162
	[0.080]**	[0.080]**	[0.080]**	[0.081]**	[0.080]**	[0.080]**	[0.080]**
Fin1*SS		-0.057					-0.078
		[0.034]*					[0.040]*
CCC*SS			-0.008				0.014
			[0.017]				[0.020]
Fin3*SS				-0.038			
				[0.020]*			
Fin2*SS					-0.037		
					[0.019]*		
(I/S)*SS						-0.01	
						[0.121]	
N. Obs	296	296	296	296	296	296	296
R-squared	0.6	0.6	0.6	0.6	0.6	0.6	0.6

Robust standard errors in brackets.

* significant at 10%, ** significant at 5%, *** significant at 1%

Table 1.7. Job Destruction, main countries 1990-2000. Dependent variable is *Destruction* for all and continuing plants, as written on each panel. All explanatory variables, except SS, are expressed as deviations with respect to their sample means. Country, time and sector fixed effects are included, we also control for Rule of law.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel (a). All firms.							
SS	0.175	0.176	0.177	0.171	0.176	0.177	0.177
	[0.034]***	[0.033]***	[0.033]***	[0.034]***	[0.033]***	[0.033]***	[0.033]***
Labor*SS	-0.377	-0.38	-0.381	-0.38	-0.379	-0.381	-0.382
	[0.103]***	[0.103]***	[0.102]***	[0.103]***	[0.103]***	[0.103]***	[0.103]***
Fin1*SS		0.08					0.047
		[0.058]					[0.084]
CCC*SS			0.035				0.022
			[0.021]*				[0.032]
Fin3*SS				0.044			
				[0.030]			
Fin2*SS					0.033		
					[0.031]		
(I/S)*SS						0.209	
						[0.172]	
N. Obs	296	296	296	296	296	296	296
R-squared	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Panel (b). Continuing firms.							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
SS	0.078	0.08	0.081	0.075	0.079	0.08	0.081
	[0.024]***	[0.024]***	[0.023]***	[0.024]***	[0.024]***	[0.024]***	[0.023]***
Labor*SS	-0.126	-0.128	-0.13	-0.128	-0.128	-0.13	-0.13
	[0.072]*	[0.072]*	[0.071]*	[0.072]*	[0.072]*	[0.071]*	[0.071]*
Fin1*SS		0.081					0.032
		[0.048]*					[0.066]
CCC*SS			0.042				0.033
			[0.017]**				[0.025]
Fin3*SS				0.044			
				[0.026]*			
Fin2*SS					0.036		
					[0.026]		
(I/S)*SS						0.289	
						[0.130]**	
N. Obs	296	296	296	296	296	296	296
R-squared	0.59	0.59	0.6	0.6	0.59	0.6	0.6

Robust standard errors in brackets.
* significant at 10%, ** significant at 5%, *** significant at 1%

Table 1.8. Job Creation main countries, time-country fixed effects with full sample. Dependent variable is *Creation* for all and continuing plants, as written on each panel. All explanatory variables, except SS, are expressed as deviations with respect to their sample means. All regressions include time-country and sector fixed effects.

			Panel (a). All Plants.			
	(1)	(2)	(3)	(4)	(5)	(6)
Fin1*SS	-0.09					-0.099
	[0.034]***					[0.044]**
CCC*SS		-0.022				0.006
		[0.015]				[0.019]
Fin3*SS			-0.054			
			[0.017]***			
Fin2*SS				-0.053		
				[0.017]***		
(I/S)*SS					-0.101	
					[0.120]	
N. Obs	484	484	484	484	484	484
R-squared	0.76	0.76	0.76	0.76	0.76	0.76
			Panel (b). Continuing Plants.			
	(1)	(2)	(3)	(4)	(5)	(6)
Fin1*SS	-0.056					-0.077
	[0.026]**					[0.033]**
CCC*SS		-0.007				0.015
		[0.012]				[0.015]
Fin3*SS			-0.04			
			[0.014]***			
Fin2*SS					-0.04	
					[0.014]***	
(I/S)*SS				0.019		
				[0.094]		
N. Obs	484	484	484	484	484	484
R-squared	0.71	0.71	0.72	0.71	0.72	0.72

Robust standard errors in brackets.

* significant at 10%, ** significant at 5%, *** significant at 1%

Table 1.9. Job Destruction, main countries, time-country fixed effects with full sample. Dependent variable is *Destruction* for all and continuing plants, as written on each panel. All explanatory variables, except SS, are expressed as deviations with respect to their sample means. All regressions include time-country and sector fixed effects.

			Panel (a). All Plants.			
	(1)	(2)	(3)	(4)	(5)	(6)
Fin1*SS	0.078					0.013
	[0.046]*					[0.060]
CCC*SS		0.049				0.045
		[0.017]***				[0.024]*
Fin3*SS			0.041			
			[0.022]*			
Fin2*SS				0.025		
				[0.024]		
(I/S)*SS					0.307	
					[0.128]**	
N. Obs	484	484	484	484	484	484
R-squared	0.76	0.77	0.76	0.76	0.77	0.77
			Panel (b). Continuing Plants.			
	(1)	(2)	(3)	(4)	(5)	(6)
Fin1*SS	0.056					-0.012
	[0.039]					[0.054]
CCC*SS		0.043				0.047
		[0.014]***				[0.021]**
Fin3*SS			0.037			
			[0.019]**			
Fin2*SS				0.026		
				[0.021]		
(I/S)*SS					0.282	
					[0.106]***	
N. Obs	484	484	484	484	484	484
R-squared	0.73	0.73	0.73	0.73	0.73	0.73

Robust standard errors in brackets.

* significant at 10%, ** significant at 5%, *** significant at 1%

Chapter 2

Cheap Maids and Nannies: How Low-Skilled Immigration is Changing the Labor Supply of High-Skilled American Women[1]

2.1 Introduction

Low-skilled immigrants work disproportionately in service sectors that are close substitutes for household production. For example, whereas low-skilled immigrant women represent 1.5 percent of the labor force, they represent more than 22 percent of the workers in private household occupations and 17 percent of the workers in laundry and dry cleaning services. Low-skilled immigrant men account for 23 percent of all gardeners in America although they represent only 2.5 percent of the labor force.[2]

The importance of low-skilled immigrants in certain economic activities has been raised as part of the recent discussion on immigration policies, particularly in the US. For example, in a recent article about immigration reform in the US, The Economist, writing about illegal immigration and the recent regulatory efforts in the US, argues that:

[1]This chapter is joint work with Patricia Cortés. I thank George-Marios Angeletos, Josh Angrist, David Autor, Marianne Bertrand, Olivier Blanchard, and Jeanne Lafortune for their excellent comments and suggestions. I also acknowledge participants in MIT's Development and Labor lunches, CEA and PUC-Chile seminars for helpful comments.

[2]Authors' calculations using the 2000 Census.

> ... in the smarter neighborhoods of Los Angeles, white toddlers occasionally shout at each other in Spanish. They learn their first words from Mexican nannies who are often working illegally, just like the maids who scrub Angelenos' floors and the gardeners who cut their lawns. ...Californians... depend on immigrants for even such intimate tasks as bringing up their children. (*The Economist*, " Debate meets reality", May 17th, 2007.)

If the recent waves of low-skilled immigration have led to lower prices of services that are substitutes for household production, we should expect natives to substitute their own time invested in the production of household goods with the purchase of the now cheaper services available in the market. Recent evidence suggests that in fact low-skilled immigration has reduced the price of these services; for example, Cortés (2006) finds that recent low-skilled immigration has reduced the prices of non-tradable goods and services, including those we are interested in in this chapter. The link between immigration and changes in the prices of household services indicates that even without effects on wages, low-skilled immigration has the potential to generate effects on natives' decisions related to time use.[3] Furthermore, these price changes should affect differently the various skill groups of the population; in particular, given that high skilled women have the highest opportunity cost of working at home production, a decrease in the price of housekeeping services is likely to have the largest impact on the labor supply decisions of this group.

Overview. This chapter uses cross-city variation in low-skilled immigrant concentration to study how low-skilled immigration has changed the labor supply of American women, particularly of the most skilled. It also explores related outcomes such as time devoted to household work and reported expenditures on housekeeping services. To identify a causal effect we instrument for low-skilled immigrant concentration using the historical distribution of immigrants of a country to project the location choices of recent immigrant flows.

Our results suggest that very high-skilled (educated) working women (those with a graduate or a professional degree) have significantly increased their supply of market work as a consequence of low-skilled immigration. The magnitudes of our estimates suggest that as a result of the low-skilled immigration wave of the 1990s, women with a graduate education increased their time working in the market by 13 minutes a week. Within this group of women, the effect on the ones with a

[3]Most, if not all, of the studies that use cross-city variation in immigrant concentration have failed to find economic and statistically significant negative effects of low-skilled immigrants on the wage of the average native high school dropout. Note however, that this is not inconsistent with immigration lowering prices of services that are close substitutes of household production, if as argued by Cortés (2006), lower prices are a consequence of lower wages but mostly for low-skilled immigrants, not natives.

professional degree or a Ph.D. is particularly large: they are working 33 minutes more a week. We do not find similar effects for any other education group.

Lawyers and physicians are the main categories represented in the group of women with professional degrees.[4] To have a successful career in either of these fields, workers have to work long hours. We find that low-skilled immigration has helped professional women increase their probability of working more than 50 and 60 hours a week. Within this group, we also find differences according to the demographics of the household, the estimated effect is significantly larger for women with children.

Our findings with respect to highly skilled women have important implications. On one hand, the results suggest that the availability of flexible housekeeping and childcare services at low prices might help female physicians and lawyers, and highly educated women in general, to advance in their careers. Conflicting demands of the profession and of the household have been linked to the relative lack of women in positions of leadership (such as partners in law firms) and in prestigious medical specializations, such as surgery.[5] On the other hand, it provides some evidence against recent theories that highly skilled women are opting out of demanding careers because they value more staying home with their children.[6] Overall, it suggests that not only cultural barriers have stopped highly educated women from a more active involvement in the labor market.

More hours of market work resulting from lower prices of household services should be reflected in less time devoted to household production. Using data from the recently released 2003-04 American Time Use Survey conducted by the Bureau of Labor Statistics and from the 1980 Panel Study of Income Dynamics (PSID), we find that the immigration wave of the 1990s reduced by a city-average of 37 minutes the time very skilled American women spend weekly on household chores.

Finally, as an additional robustness check on our labor supply estimates, we use data from the Consumer Expenditure Survey (CEX) to test if highly educated women have changed their consumption levels of market-provided household services as a consequence of low-skilled immigration. Given that expenditures, not units of consumption, are reported in the CEX, the exact sign and magnitudes of our estimates depend on the price elasticity of these services; in the case of dollar

[4]See table B.2.

[5]"While many women with children negotiate a part-time schedule for family care... they are still less likely to be promoted to partner than women who stay in firms but do not use part time options"... "The expectation that an attorney needs to be available paractically 24/7 is huge impediment to a balanced work/family life" (Harrington and Hsi, 2007).

[6]The headline for the October 26 2003 edition of the *New York Times Magazine* was "Why don't more women get to the top? They choose not to."

expenditures, a unit price elasticity implies we should observe zero effect on the amount spent on these services. We also study in separate regressions if the immigration waves have made households more likely to report any positive expenditure on these services. We find evidence that the immigration flows of the last two decades have increased the expenditures in housekeeping services among households with high educational attainment.

Related Literature. Our chapter provides a new perspective on the literature of the labor market effects of low-skilled immigration. We move away from the past focus on the effects on the groups of natives competing directly with immigrants (Altonji and Card, 1991; Borjas, 2003; Borjas, Freeman and Katz, 1996; Card, 1990, 2001; Ottaviano and Peri, 2006) and explore a potentially important dimension in which low-skilled immigrants affect the average level of native welfare and its distribution: the time-use effects of a decrease in prices of services that are close substitutes for household production.

Ours is not the first work to study the employment effects of low-skilled immigration; previous papers whose main focus is on wage levels also include regressions of employment levels. There is a great deal of dispersion in the findings reported by the various studies. As expected, studies that find no effect on wages also find no effect on employment or labor force participation. In his Mariel Boatlift paper, Card concludes that the 1980 influx of Cubans to Miami had no effects on the employment and unemployment rates of unskilled workers, even for earlier cohorts of Cubans.[7] A similar result is obtained by Altonji and Card (1991), who find no significant effect of low-skilled immigrants on the labor force participation and hours worked of low-skilled native groups. On the other hand, Card (2001) calculates that " the inflow of new immigrants in the 1985-90 period reduced the relative employment rates of natives and earlier immigrants in laborer and low-skilled service occupations by up to 1 percentage point, and by up to 3 percentage points in very high-immigrant cities like Los Angeles or Miami." It is unclear from his results, however, if the displaced workers in these occupations moved out of the labor force, or simply shifted to another occupation. The estimates in Borjas (2003) suggest that a 10 percent supply shock (i.e. an immigrant flow that raises the number of workers in an education-experience skill group by 10 percent) reduces by approximately 3.5 percent the fraction of time worked by workers of that skill group (measured as weeks worked divided by 52 in the sample of all persons, including nonworkers). The effect is significantly smaller and not statistically significant when the sample is limited to high school

[7]See Card (1990).

dropouts.

Our work is also related to the literature on female labor supply and child care provision and prices. Gelbach (2002) estimates the effect of public school enrollment for five-year-old children on measures of maternal labor supply using as an instrument for enrollment the quarter of birth of the child. His main results suggest that public pre-school enrollment of a child has a strong effect on the labor supply of the mother, especially on single women whose youngest child is five years old, and on all married women with a five-year-old child. Strong effects of the availability/price of child care on labor supply are also found by Baker, Gruber and Milligan (2005), who study the introduction of universal, highly subsidized childcare in Quebec in the late 1990s. The authors estimate difference-in-differences models comparing the outcomes in Quebec and the rest of Canada around the time of this reform. Using additional information on family and child outcomes they also find that the provision of this subsidy has been associated with worse outcomes for the children. Our work differs from these papers in the experimental set-up: the magnitude of the variation in prices generated by immigrants is of a different order of magnitude than the ones considered in the two studies mentioned above. We also consider the effect of changes in prices in services other than childcare, which might also affect women with no children.

Layout. The rest of this chapter is organized as follows. The next section presents a theoretical framework for the time allocation/household work problem. Section 2.3 describes the data and the descriptive statistics. Section 2.4 presents the empirical strategy. Then we discuss the main results in section 2.5, and in section 2.6 we present the conclusions and some directions for future research.

2.2 Theoretical Framework

2.2.1 A Simple Time Use Model

The model follows the household production-time use model developed in Gronau (1977).

Consider an agent with preferences given by

$$U(x, z) = u(x) + v(z) \tag{2.1}$$

where x is the consumption of goods and services and z is leisure time. Assume $u(\cdot)$ and $v(\cdot)$ are strictly concave, strictly increasing in their arguments. Also, $u(\cdot)$ satisfy Inada conditions at 0 and $v(\cdot)$ satisfies Inada conditions at 1 and 0. We introduce household production as in Gronau

(1977), i.e. assuming that x can be purchased in the market or produced at home using time, h, according to a *household production function* $f(h)$, and that the agent is indifferent between them. We assume $f(\cdot)$ is strictly increasing and concave, and $\lim_{h\downarrow 0} f'(h) = \infty$. Denoting by x_m market purchases, the following equation gives us total consumption of goods and services as the sum of market and home produced goods:

$$x = x_m + f(h). \tag{2.2}$$

Equation (2.2) assumes that services purchased in the market and the services produced by the agent in the household are perfect substitutes. Notice, however, that the concavity of the household production function $f(\cdot)$ implies that substitution is less than perfect between *household time* and *market services.* Moreover, the assumption of Inada conditions for the production function $f(\cdot)$ is sufficient to guarantee that the agent will always spend a strictly positive amount of time in household work. In other words, the agent will never, at any price, buy all of her childcare or housekeeping on the market.

The (endogenous) budget constraint is

$$I + wl = px_m, \tag{2.3}$$

where I is non labor income (measured in "dollars"), l is hours of market work, and p is the price of market goods. The agent also faces the time constraint:

$$1 = l + z + h, \tag{2.4}$$

with total time normalized to be 1.[8]

The agent maximizes (2.1) subject to (2.2), (2.3) and (2.4), plus nonnegativity constraints on h, and l.[9] We use (2.4) to eliminate leisure from the optimization problem. Note that the properties

[8]Using (2.4) to eliminate j from (2.3) we obtain

$$\underbrace{R + w}_{\text{full income}} = px_m + w(h + l),$$

where the left hand side corresponds to *full income* in this set-up, see Becker (1965).

[9]The restriction that $x_m \geq R/p$ is redundant after we impose strict equality of the budget constraint and nonnegativity of the labor supply.

of $f(\cdot)$ guarantee that h cannot be 0, thus the agent's problem is

$$\max_{x_m,h,l} u(x_m + f(h)) + v(1 - l - h). \tag{P}$$

$$[\lambda] \qquad I + wl = px_m$$

$$[\eta] \qquad l \geq 0$$

We can see that the change in the price of the market services, p, will have an effect on the *real* value of labor and non-labor income, in order to separate these effects we will first look at the problem with no non-labor income ($I = 0$), and then will see how results change when we lift this assumption.

Household Production and Labor Supply with $I = 0$

In this case we can write the optimization problem as

$$\max_{h,l} \widetilde{U} = u\left(\frac{w}{p}l + f(h)\right) + v(1 - l - h). \tag{P1}$$

$$[\eta] \qquad l \geq 0$$

Lemma 2.1 *In the agent's optimization problem P1, there exists ω such that if*

- $\frac{w}{p} > \omega$, *the agent participates in the labor market ($l > 0$), and household work, h, is such that* $f'(h) = \frac{w}{p}$;

- $\frac{w}{p} \leq \omega$, *the agent does not participate in the labor market ($l = 0$), and household work, h, is given by the solution to*

$$\max_{h} \ u(f(h)) + v(1 - h), \tag{P1'}$$

or equivalently

$$f'(h) = \frac{v'(1 - h)}{u'(f(h))}. \tag{2.5}$$

The results in the previous lemma indicate that agents with a higher wage should be more likely to participate in the labor force, all else equal. Notice also that the solution when not participating in the labor force is independent of w and p. The effects of a fall in the price of market services are stated in the next lemma.

Effect of a Reduction in p Our main motivation is that low-skilled immigration drives down the price of the services that are close substitutes of the time spent at home in productive activities. We look at two sets of results, first, the comparative statics of labor supply, market purchases of services and time spent at home on household production. Second, the effects on labor force participation.

Lemma 2.2 *In the case when $I = 0$ and $w/p > \omega$, the effects of a fall in p are*

1. *household work, h, decreases, i.e.*

$$\frac{\partial h}{\partial p} = -\frac{w}{p^2 f''(\cdot)} > 0, \tag{2.6}$$

2. *consumption of market services, x_m, goes up,*

$$\frac{\partial x_m}{\partial p} = -\frac{\frac{w}{p^2}\left(lv''(\cdot) - \frac{f'(\cdot)}{f''(\cdot)}\Omega\right)}{\Pi} < 0, \tag{2.7}$$

3. *and, labor supply, l, may increase or decrease,*

$$\frac{\partial l}{\partial p} = -\frac{\partial h}{\partial p}\frac{\Omega}{\Pi} + \frac{1}{\Pi}\left[\frac{w}{p^2} lf'(\cdot)\, u''(\cdot)\right] \tag{2.8}$$

where

$$\Omega = f''(\cdot)\, u'(\cdot) + f'(\cdot)^2\, u''(\cdot) + v''(\cdot) = \frac{\partial \widetilde{U}}{\partial h} < 0,$$

and

$$\Pi = v''(\cdot) + \left(\frac{w}{p}\right)^2 u''(\cdot) = \frac{\partial \widetilde{U}}{\partial l} < 0.$$

4. *As the variable that matters is w/p, the comparative statics with respect to w have exactly the reverse signs.*

When $w/p \leq \omega$, $l = x_m = 0$ and h is independent of w and p.

The first two results in these lemma are simple. A fall in p makes market work relatively more attractive as the real wage increases: agent substitutes away from her own time and towards market purchases. In the case of market purchases there are two effects that work in the same way: holding constant x, market provided services are cheaper and hence *production* shifts towards them (a pure substitution effect), but also x is now cheaper and hence total demand for x increases (a scale effect).[10] In the case of labor supply, there is one more effect at play, captured in the terms inside the bracket on the right hand side of equation (2.8), and it corresponds to a *valuation* effect: total labor income, wl, is now equivalent to more units of market services.

We now want to look at the effects of p on labor force participation. The last result in Lemma 2.2 states that when the agent does not participate in the market, her household production decision is independent of p. On the other side, if participating in the labor market, the hours work at home are decreasing in p. This implies that at some point, a decrease in p will make these two values of h coincide, and the agent will become a participant in the labor market. These result is then just a simple corollary from Lemma 2.2, and it is stated next.

Corollary 2.1 *For a given w, $\exists\ \widehat{p} = w/\omega$ such that iff $p < \widehat{p}$, the agent participates in the labor market.*

The Model with Non-labor Income

We now incorporate I into the budget constraint of the agent. This extra term will bring in another effect, as reductions in p will also generate real income effects through I. We can now write problem (P) as

$$\max_{h,l} \widetilde{U} = u\left(\frac{w}{p}l + \frac{I}{p} + f(h)\right) + v(1 - l - h). \tag{P2}$$

$$[\eta] \qquad l \geq 0$$

The solution to this problem is qualitatively similar to the case with no non-labor income. There are two cases depending on whether the agent participates in the labor market. Unlike the previous case, now it is not just w/p what matters for labor supply, because the real value of non-labor income, I/p, also plays a role (and does it too in the case where the agent does not participate).

Points X_A and H_A in Figure 2-1 corresponds to the case when the agent does participate in the labor market. In this case, we see her spend h_A units of time in household production, z_A units in leisure, and $(1 - h_A - z_A)$ in market work. Point H_A is the point where the production function $f(\cdot)$ has a slope equal to w/p; the straight black line is the corresponding budget constraint, and at

[10] Notice that our assumptions about preferences and time allocation lead to the result that the scale effect does not affect the household production decision at the margin.

point X_A the indifference curve is tangent to the budget constraint. Notice also that at the point where an indifference curve is tangent to the household production function the slope $f'(\cdot)$ would be lower than w/p.

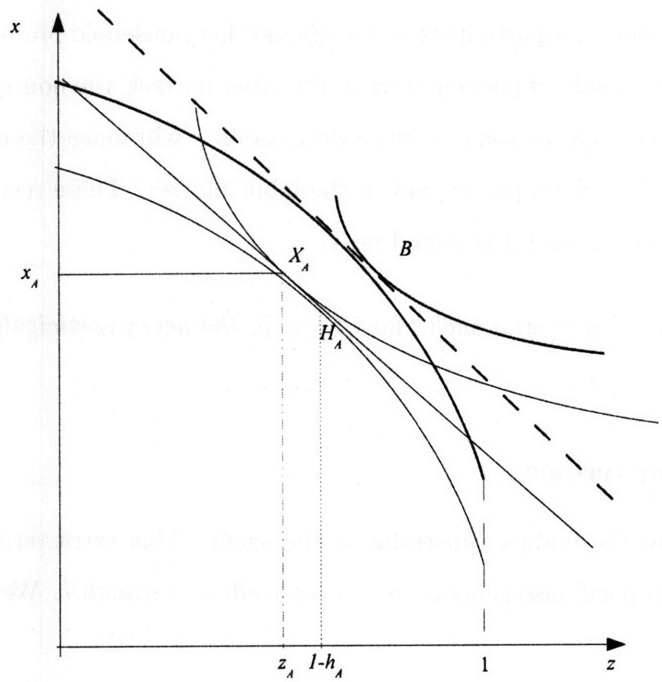

Figure 2-1. Household Production and Labor Supply with $I > 0$.

Effect of a Reduction in p The positive non-labor income adds another channel to the effects of the reduction in p. However, not all the results stated before for the case of $I = 0$ will change. The optimality condition for h and the comparative statics are the same in the case when the agent participates in the labor market. But, now h is not independent of p when the agent does not participate, it corresponds to the solution to

$$\max_h \; u\left(\frac{I}{p} + f(h)\right) + v(1-h),$$

and the price of the market services affect the decision of the agent through the valuation effect on I.[11]

Finally, unlike the previous case, the effect of a fall in p on labor force participation is ambiguous. The extra effect coming from the increase in the real value of I changes the characteristics of the problem. Consider a fall in p, like the one represented blue lines in figure 2-1. The curved blue line that is discontinuous at $z = 1$ corresponds to a vertical shift in the production frontier described by $f(\cdot)$; this shift reflects the fact that I is not equivalent to more units of x_m. The dashed blue line corresponds to the budget constraint. Notice that in this case, point B is not feasible, as it would imply a negative labor supply, hence the agent choose to become inactive. Two elements play a role here: first, that immigration generates a significant effect on the *total* price of market services (and goods), as summarized by p, and second, that the income elasticity of leisure is sufficiently high, so that most of the income effect translates into an increased demand for leisure.

2.2.2 Other Effects

In order to keep the model simple we have abstracted from two other elements that we will exploit later in our empirical strategy. We briefly indicate here how and why we expect them to affect the time-use decisions.

Consider first the case of demographic composition of the household. Until now we looked at the problem as that of a single agent, but there are two relevant details about the household composition. First, the spouse's income/labor supply decision, in particular, we will try to capture part of this effect using a dummy variable for the education level of the husband in some of our regressions. Second, if there are children at home, then the parents will probably face the need to spend time with them or to be able to find a person to care for them while they work. In their case, there is a higher need for market services, and thus, they should be more sensitive to the price and availability of these services in the market. Hence, we expect the effect of low-skilled immigration on female labor supply to be stronger in the case of women with children at home.[12]

[11] We can show that in this case the effect of a fall in p on the time spent working at home when the agent does not participate in the labor market is negative, i.e.

$$\frac{\partial h}{\partial p} = \frac{f'(\cdot)\,u''(\cdot)\,\frac{I}{p^2}}{f''(\cdot)\,u'(\cdot) + f'(\cdot)^2\,u''(\cdot) + v''(\cdot)} > 0.$$

[12] Notice though that public schools play a similar role in this case, as they provide childcare services by keeping children at school during (part of) the day, see Gelbach (2002) for a study that exploits this fact to study the labor supply effects of childcare availability.

We also consider the effect of professional choices. As we explain in the introduction, some careers require tough time commitments, with a lot of hours of work and flexibility to deal with high workloads. Most of them also come together with higher wages than in more " flexible" or " family friendly" occupations. Taking a job that requires longer hours at a higher wage generates two effects: with less time available for household work and leisure the agent has a higher marginal value of sacrificing leisure for household production, but also gives more resources to pay for market services. Lower p then makes the choice of taking the time consuming job less burdensome, as it is cheaper to acquire the goods and services from the market, and it also increases its real wage. Given this logic, we explore whether women with professional titles or working on activities that demand long hours of work have changed their labor supply as a result of the recent waves of low-skilled immigration.

2.3 Data and Descriptive Statistics

Immigration Data. This study uses the 1980, 1990, and 2000 Public Use Microdata Samples (PUMS) of the Decennial Census to measure the concentration of low-skilled immigrants among cities and industries. Low-skilled workers are defined as those who have not completed high school. An immigrant is defined as someone who reports being a naturalized citizen or not being a citizen. We restrict the sample to people age 16-64 who report being in the labor force.

Table 2.1 shows the evolution of the share of low-skilled immigrants in the labor force for the 25 largest cities in the US. As observed there is large variation in immigrant concentration both across cities and through time. Table 2.2 presents the 15 industries with the highest share of low-skilled immigrants, low-skilled female immigrants, and low-skilled male immigrants in the year 2000. With the exception of agriculture and textiles, almost all other industries fall into the category of services that are close substitutes to household production: landscaping, housekeeping, laundry and dry cleaning, car wash and shoe repair (the Census does not include babysitting as a separate industry). The low-skilled immigrant concentration in these services is very large. For example, whereas low-skilled immigrant women represented 1.9 percent of the total labor force in the year 2000, they represented more than 25 percent of the workers in private household occupations and 12 percent of the workers in laundry and dry cleaning services. Similarly, the immigrant men's shares in gardening and in shoe repair services were 9 and 6 times larger, respectively, than their share in the total labor force.

Market Work Data. We also use the Census to quantify the changes in hours worked and labor force participation due to the inflow of low-skilled immigrants. As Table 2.3 shows, labor force participation and the number of hours worked a week increase systematically with the education level of the woman. Women with a graduate degree, a college degree, and some college present a significant increase in their labor force participation between 1980 and 1990.[13] During the last decade, participation of all education groups has stabilized, and if anything it has gone down. We also observe that the group of women with a graduate degree is the only one that experienced an increase in the probability of being married. The increase in marriage rates is particularly acute for women with professional degrees and Ph.D.'s, who in 2000, were also much more likely to have a child younger than 6 years old than they were in 1980.

Table 2.3 also includes the share of women with a professional degree or Ph.D. that reports working at least 50 or 60 hours a week (conditional on positive hours). Almost a third of professional women reported working 50 hours or more a week in 2000, a double-fold increase from 1980, and three times, two times, and fifty percent more likely than women with at most some college, college degree, and masters degree, respectively. Highly educated women are also at least twice as likely, compared to any other educational group, to work 60 hours or more a week.

Household Work Data. We combine information from the 2003-2005 ATUS and the 1980 PSID to measure the effect of low-skilled immigration on time devoted to household work.

Since 2003, the BLS has been running the ATUS, a monthly survey, whose sample is drawn from CPS – two months after households complete their eight CPS interviews. An eligible person from each household is randomly selected to participate, and there are no substitutions. The week of the month and the day of the week on which the survey is conducted is randomly assigned; weekends are oversampled, they represent 50 percent of the sample. The overall response rate is 58 percent and the aggregated sample for 2003 and 2004 consists of approximately 38 000 observations.

Until the ATUS, only scattered time-use surveys were available for the US –all of them with too few observations to provide reliable information about city-averages of time allocation. Though not a time-use survey, the PSID included between 1970 and 1986 a question about average hours a week spent by the wife and head of household on household chores. We construct a similar variable using the ATUS data. Specifically, we aggregate daily time spent on food preparation, food cleanup,

[13]Note that the characteristics of the educational groups are likely to change significantly over time because of composition issues. For example, whereas in 1980 only 7 percent of wives in the sample had a college degree, by 2000 this number has increased to 17 percent.

cleaning house, clothes care, car repair, plant care, animal care, shopping for food and shopping for clothes/HH items, multiply this aggregate by 7 and divide it by 60. Any difference in the definition of household work we hope to capture using decade dummies.

For both surveys, our sample consists of women ages 21-64 that have completed the survey. Table 2.4 presents the descriptive statistics of our time use data. In both years, time spent on household chores decreases as the education of the woman increases, and labor force participation increases with education. The data suggests that time devoted to household work has decreased significantly for all groups of women, and hours worked in the market (conditional on working) have been stable. Although the changes across years might be partially due to differences in the surveys, the fact that hours of household work have not changed much for men (and have actually increased for highly educated men) suggests that a reduction in household work for women has taken place, and that a big part of it might be explained by the increased participation of women in the labor force.[14] Note that PSID's and ATUS's statistics on labor force participation of women and usual hours worked are not very different from the Census.

Consumption Data. We use CEX data to construct two measures of consumption of market supplied household services. First, in order to capture the extensive margin, we consider a dummy variable for positive reported expenditures in household services. Second, we also consider the amount spent on each of these services, a measure we identify as capturing mostly the intensive margin and that allows us to have an estimate of the elasticity of demand.[15] As observed in Table 2.5, both the probability of consuming household services and the amount spent on them increase significantly with the education level of the wife / female head of the household. Expenditures on household services differ by the education of the main adult female in the household (either the head's wife or the head herself). Whereas only 3 percent of households where such a female has at most a high school degree reported positive expenditures on this category, that fraction rises to 3, 8, 15 and 22 percent when considering females with respectively at most a high school degree, some college, a college degree, or a graduate degree. The last group was also the only one to experience a systematic increase in the probability of reporting positive expenditures across the three decades.

[14]The discussion on composition issues of the market work data also applies for the descriptive statistics presented in Table 2.4.

[15]We do not include child-care at home because the variable in the CEX was redefined between 1990 and 2000.

2.4 Empirical Strategy and Estimation

2.4.1 Identification Strategy

We exploit the intercity variation in the (change of) concentration of low-skilled immigrants to identify their effect on the time use decisions of American women and purchases of household services in American households. There are two concerns with the validity of the strategy. First, immigrants are not randomly distributed across labor markets. If immigrants cluster in cities with thriving economies, there would be a spurious positive correlation between immigration and labor force participation of women, for example. To deal with this potential bias, we instrument for immigrant location using the historical city-distribution of immigrants of a given country. The instrument will be discussed thoroughly in section 2.4.3.

The second concern is that local labor markets are not closed and therefore natives may respond to the immigrant supply shock by moving their labor or capital to other cities, thereby re-equilibrating the national economy. Most of the papers that have studied this question, however, have found little or no evidence on displacement of low-skilled natives (Card, 2001; Cortés, 2006).[16] In any case, if factor mobility dissipates the effects of immigration flows to cities, our estimates should provide a lower bound for the total effect of low-skilled immigration on the time use of natives.

2.4.2 Econometric Specification

Ideally, and as suggested by our theoretical framework, we would have liked to use price indexes (in particular, the price index of household services in a city) as the explanatory variable in our analysis of time use and consumption. Unfortunately however, the price data used in Cortés (2006) is available only for 25 cities in the US, and given the reduced sample the variation, it is not large enough to identify the effects we are interested in. As a result, and in order to expand the sample, we use a variable that captures (part of) the determinants of the prices of services.

Following the results in Cortés (2006), we compute

$$\mathcal{L}_{it} = \ln\left(\frac{(\widehat{\beta} L^{\widehat{\rho}} + (1-\widehat{\beta}) I^{\widehat{\rho}})^{\frac{1}{\widehat{\rho}}}}{H}\right)_{it} \tag{2.9}$$

where L represents the supply of native low-skilled labor, I the supply of immigrant low-skilled

[16] The exception is (Borjas et al., 1996).

labor, and H native high-skilled labor in city i and year t; $\widehat{\beta}$ and $\widehat{\rho}$ correspond to Cortés's (2006) estimates of β and ρ, respectively. $\mathcal{L}_{it}$ then corresponds to the ratio of " aggregate" low- to high skilled workers in city i at time t; the numerator corresponds to the " aggregate" units of low-skilled labor, this aggregate reflects the assumption that natives and immigrants are not perfect substitutes in the labor market.

Labor Supply. The size of the Census sample allows us to run a separate regression by education group for the study of labor supply. The explanatory variables of interest are a dummy for labor force participation, usual hours a week worked (conditional on working) and the probability of working at least 50 or 60 hours a week. We use the following specification:

$$y^e_{nit} = \delta^e * \mathcal{L}_{it} + X_n' \Lambda^e + \phi^e_i + \psi^e_{jt} + \varepsilon^e_{ijt} \tag{2.10}$$

where e is education group. Vector X_n are individual level characteristics, namely age, age squared, race and marital status. Henceforth, ϕ_i and ψ_{jt} represent city and region*decade fixed effects, respectively. Finally, $\mathcal{L}_{it}$ is given in equation (2.9).

Our hypothesis is that $\delta^e > 0$ and $\delta^{\text{graduate}} > \delta^{\text{college}} > \delta^{\text{somecollege}}$ and so on; the coefficients should reflect, partially at least, the fact that the alternative cost of time spent at home is increasing in education.

Time devoted to household work. Because of the reduced number of observations, we cannot run a separate regression for each education group. Therefore, we estimate one regression and restrict the coefficients on individual characteristics and the city and decade*region fixed effects to be equal for all education groups. We do allow for the effect of low-skilled immigration to differ by the education level of the woman. The specification is the following:

$$y_{nit} = \sum_e \pi^e * \mathcal{L}_{it} * dummy\_educ_{nit} + X_n' \Lambda + \theta_e + \phi_i + \psi_{jt} + \varepsilon_{ijt} \tag{2.11}$$

where y_{nit} now represents the average hours a week woman n spends doing household work in city i and year t and θ_e education level fixed effects.

If the price of a market substitute goes down, women should reduce their time spent doing household work. Therefore, we expect $\pi^e < 0$. We also expect $|\pi^{\text{graduate}}| > |\pi^{\text{college}}| > |\pi^{\text{somecollege}}|$: ceteris paribus, given their high opportunity cost of time, the most skilled women should be the ones to reduce by the most their time devoted to household chores.

Consumption of Housekeeping Services. We use a similar, but more restricted specification than the one above:

$$y_{nit} = \kappa * \mathcal{L}_{it} + \nu * \mathcal{L}_{it} * Grad_{nit} + X_n'\Lambda + \phi_i + \psi_{jt} + \varepsilon_{ijt} \tag{2.12}$$

where n represents a household, i city, j region, and t year. y is an outcome taken from the expenditure data; it can be either a dummy variable for positive reported expenditures in housekeeping services, or the amount spent, in dollars, on them. $Grad_{nit}$ is a dummy variable for whether the wife or female head of the household has a graduate degree. The vector X_n are household level characteristics, namely age, sex, and education of the wife or female head of the household (includes a dummy for graduate degree), and household size and demographic composition. As we mentioned earlier, ϕ_i and ψ_{jt} represent city and region*decade fixed effects, respectively.

We expect $\kappa, \nu > 0$, i.e. an immigrant induced increase in the relative endowment of low-skilled vs. high-skilled workers, by reducing the prices of housekeeping services, increases the probability a household purchases housekeeping services, more so for the highest skilled households. If the elasticity of demand for housekeeping services is greater than one, κ, and/or $(\kappa + \nu)$ should also be positive in the regression where the dependent variable is the level of expenditures in housekeeping services.

We estimate equations (2.10) to (2.12) using 2SLS, instrumenting $\mathcal{L}_{it}$, the relative endowment of low-skilled vs. high-skilled workers, with the variable we describe below in section 2.4.3. We cluster all of the standard errors at the city-decade level.

Deriving the Effects of Low-Skilled Immigration. Given that what we are ultimately interested in the magnitude of the effect of immigration flows on consumption and time use, we use the chain rule for its estimation:

$$\begin{aligned} \frac{dy}{d\left(\ln \overline{I}\right)} &= \frac{dy}{d\mathcal{L}} * \frac{d\mathcal{L}}{d(\ln \overline{I})} \\ &= \theta * \left(\frac{(1-\beta)I^{\rho}}{\beta L^{\rho} + (1-\beta)I^{\rho}} \right), \end{aligned} \tag{2.13}$$

where θ is the coefficient that measures the impact of $\mathcal{L}$ on outcome y (i.e. $\theta \in \{\delta, \pi, \kappa, \nu\}$).

The last equality is based on the assumption that $\frac{d(\ln L)}{d(\ln I)} = 0$, i.e. there are no displacement effects. Note that $\left(\frac{(1-\beta)I^\rho}{\beta L^\rho + (1-\beta)I^\rho}\right)$ varies significantly by city. We use the value of $\left(\frac{(1-\beta)I^\rho}{\beta L^\rho + (1-\beta)I^\rho}\right)$ for each city from the 1990 Census to calculate the city-specific immigration effect on consumption and time use of the low-skilled immigration flow of the 1990s. We report the average across cities of these effects unless explicitly noted.

Our motivating theory and the discussion we have introduced so far has focused on the case where the wages of native workers do not respond to the low-skilled immigrants. It is not unreasonable to assume that for lower education groups, although not perfect substitutes of low-immigrants (as we assume in our motivation) the increased inflow of other low-skilled workers may generate some wage or employment effects. However, these effects are less likely to be present in the most educated groups, which are the focus of our study. We try to address any potential problem along these lines by running separate regressions for each educational achievement group whenever that is possible. Our assumption of no wage and/or employment effects are more likely to hold for our group of interest: highly-skilled educated women.

2.4.3 Instrument

The instrument exploits the tendency of immigrants to settle in a city with a large enclave of immigrants from the same country. Immigrant networks are an important consideration in the location choices of prospective immigrants because these networks facilitate the job search process and the assimilation to the new culture (Munshi, 2003). The instrument uses the 1970 distribution of immigrants from a given country across US cities to allocate the new waves of immigrants from that country.

The instrument is likely to predict new arrivals if: (1) there is a large enough number of immigrants from a country in 1970 to influence the location choices of future immigrants, and (2) there is a steady and homogeneous wave of immigrants after 1970. Therefore, we include in the instrument the countries that were in the top 5 sending countries in 1970, and which continued to be important senders of immigrants in the decades that followed. As can be seen in Table 2.6, only Mexico, Cuba, and Italy satisfy these conditions.[17] Many European countries and Canada, important contributors to the low-skilled immigrant population in 1970, were replaced by Latin American and Asian countries starting in 1980.

[17] See Cortés (2006) Appendix C, Table C1 for the first stage for instruments that include alternative sets of countries.

Formally, the instrument can be written as:

$$\ln\left(\frac{Mexicans_{i,1970}}{Mexicans_{1970}} * LSMexicans_t + \frac{Cubans_{i,1970}}{Cubans_{1970}} * LSCubans_t + \frac{Italians_{i,1970}}{Italians_{1970}} * LSItalians_t\right), \tag{2.14}$$

where $\frac{Mexicans_{i,1970}}{Mexicans_{1970}}$ represents the percentage of all Mexicans included in the 1970 Census who were living in city i, and $LSMexicans_t$ stands for the *total* flow of low-skilled Mexican immigrants to the US between 1971 and decade t. Similar notation is used for Cubans and Italians. We use all Mexicans, Cubans, and Italians in the US –and not only low-skilled workers– to construct the initial distributions. This maximizes the number of cities included in the analysis.

As Table 2.7 shows, the instrument is a good predictor of the relative endowment of low-skilled vs. high-skilled workers in a city. The size of the coefficient is significantly larger when the sample of cities is that of the CEX, consequence, most likely, from the sample including fewer but larger cities.

Identification Assumption. All of the econometric specifications in this chapter include city (ϕ_i) and region*decade (ψ_{jt}) fixed effects; therefore, the instrument will help in identifying the causal effect of immigration concentration on time use as long as the unobserved factors that determined that more immigrants decided to locate in city i vs. city i' in 1970, both cities in region j, are not correlated with *changes* in the*relative* economic opportunities offered by the same two cities (or other factors that might have had affected the time use of women) during the 1990s.

An additional concern is the violation of the exclusion restriction, i.e., that low-skilled immigrant concentration might affect the time use of American women through other channels besides changing the prices of household related services, in particular, through lowering the wages of competing natives. We use two arguments to make the case that the effects we find are mainly driven by changes in services' prices. First, Cortés (2006) and many previous studies have found no significant effect of immigrants on the wages of competing groups of natives, including low-skilled native women. Furthermore, our focus on highly educated women reduces the likelihood that their wages are indeed directly affected by low-skilled immigration. Second, we find that low-skilled immigration disproportionately affects the time use of highly educated women, a result consistent with our initial suggestion that effects should be stronger on groups that have a positive demand for these services; and as we mentioned already, a group that is less likely to be affected by direct wage effects.

We should emphasize that even if the exclusion restriction is violated, our estimates still capture the causal effect of low-skilled immigration on the time use of American households. Hence, even in this case our results still show different effects for different groups of the population, reinforcing the idea that not all groups are equally affected by immigration. However, a violation of the exclusion restriction invalidates the use of our framework as a test for time use models, and therefore of our estimates as measures of the services' price elasticities of labor supply. We believe that if this were the case our estimates still document causal relations and stylized facts that have not been previously explored in the literature.

2.5 Results

Our results explore the three outcomes of the household decision that we have described before: labor supply, home production and household services expenditures. After presenting the results for each of them, we summarize the results for the case of highly-skilled women, to emphasize our view that they reflect a change in the use of time as a response to the lower prices of services.

2.5.1 Market Work

Tables 2.8 and 2.9 present the estimation of equation (2.10) with labor supply as the dependent variable. Each number in the tables comes from a different regression, where the explanatory variable of interest is the relative labor supply of low-skilled vs. high-skilled workers, appropriately instrumented, and the sample is restricted to a given education group.

Table 2.8 shows that for the labor force participation equation, all the relevant coefficients are negative and statistically significant (with the exemption of the one in the specification for women with professional degrees), and that the magnitude of the coefficient does not vary with the education level of the woman. This result goes against our theory, and will be further confirmed by the household work regressions.

Results on usual hours per week worked conditional on working and on the probability of working at least 50 and 60 hours are supporting of the theory and very statistically significant. As observed in Table 2.8 the effect of the relative supply of low-skilled vs. high-skilled labor on usual hours of work increases systematically with the education level of the woman, and it is statistically significant only for women with a master's or professional degree. Within this highly skilled group the effect is much more pronounced for women with professional degrees or Ph.D.'s. The estimated coefficients, 1.66 and 7.78, imply that the low-skilled immigration shock of the 1990s increased by 7 minutes a week the time women with master's degree devoted to market work, and by 33 minutes for women with a PhD or professional degree.

Lawyers, physicians and women with Ph.D.'s are the main categories represented in the group of women with professional degrees (see table B.2). In both fields, having a successful career requires the workers to have long hours of work. Doing so is specially challenging for women, who are usually responsible for household work and the care of children. Being able to buy from the market housekeeping services and, specially, child care services at unusual hours allows women with a professional degree or Ph.D. to compete with their male counterparts. Table 2.9 shows how low-skilled immigration has helped professional women increase their probability of working more than 50 and 60 hours (both unconditionally and conditional on working). The fact that the effect is increasing in education level and especially large for women with a professional degree or Ph.D. suggests that the mechanism through which low-skilled immigration is affecting the probability of working long hours is likely to be through a reduction in the prices of market substitutes for household production. The magnitude of the effect is economically significant: the low-skilled immigration flow of the 1990s increased by 2 percentage points, a 7.4 percent increase in the 1990 probability, the probability that a working woman in these groups of the population reported working more than 50 hours a week, and by 0.6 percentage points the probability of working at least 60 hours, a 5 percent increase.

Professional women with small children and even with children of school age should be particularly sensitive to changes in prices of housekeeping and childcare services. Table 2.10 shows that the interaction of the relative endowment of low-skilled vs. high-skilled labor with a dummy for having a child 5 or younger or with a dummy for having children 17 or younger is always positive and highly statistically significant. Interestingly, the interaction of the educational level of the spouse (husband) has a negative (and significative) effect on the impact of low-skilled immigration of the labor supply measures. Although not a clean test, we interpret this result as evidence that income effects play some role in the labor supply decision.

2.5.2 Household Work

In Table 2.11 we present the estimations of equation (2.11). Confirming our previous results, the estimates show important variation by educational group.[18] For highly educated women we find a

[18] Surprisingly, the " average" effect of the relative labor supply of low-skilled vs. high-skilled workers is positive and statistically significant when ignoring the heterogeneity we document.

negative effect of the relative labor supply of low-skilled vs. high-skilled workers on household work, a result in accordance with our original conjectures and with our previous finding that low-skilled immigration has increased hours worked by working women with a graduate degree. Its magnitude suggests that the low-skilled immigration flow of the 1990s reduced by 34 minutes the time a week devoted to household work by women with a graduate degree. Note that with the ATUS and PSID we cannot further disaggregate this highly educated group into women with a master's degree and women with a professional degree or Ph.D., so the magnitude could be even larger for the latter group. Given that the magnitude of the decline in household work of women with a graduate degree is larger than that of the increase in hours worked in the market, it is likely that leisure time for this group of women also increased. Unfortunately, we cannot test this hypothesis with our data.

For all other education groups, women experienced a positive but not statistically significant effect of immigration on household work, the sole exception being women with at most a high school degree for which the effect is statistically larger than 0. Although this effect seems a bit surprising, it could be at least partially explained by various hypotheses. First, even if the literature has failed to find an effect on the wages of low-skilled natives, there might be other channels through which low-skilled immigrants affect the time use of low-skilled natives. For example, women with at most a high school degree, or other groups similar to this in their employment characteristics, are competing more directly with immigrants in labor markets; thus receiving a more direct impact on their employment choices or opportunities.

Another potential explanation for this result is that we cannot exclude from the regression (or control for) foreign women. If the share of foreign women in a city-education group is correlated with the share of low-skilled immigrants in the labor force, and foreign women tend to devote more time to household work, then we might find the positive correlation we describe. However, the share of foreign women has to be implausibly large to explain the magnitude of the coefficient.

Alternatively, the result might be related to the also puzzling negative effect of low-skilled immigration on labor force participation of all education groups. Suggestive evidence that the negative effect on labor force participation might help account for the result is that the coefficient becomes much smaller (though still positive) and not statistically significant when the sample is restricted to working women. However, the labor force participation effect did not vary as much by education level and was specially large for women with a high school degree.[19]

[19]We also study the effects on household work using the 2003 and 2004 ATUS (American Time Use Survey), and the Fall 92-Summer 94 National Human Activity Pattern Survey (NHAPS). The results obtained are consistent with the evidence we find with our prefered database in the household work dimension. However, the small sample size of

2.5.3 Consumption

Using CEX data from 1980, 1990, and 2000, we estimate equation (2.12) and summarize the results in Table 2.12. The upper panel reports the estimation when the dependent variable is a dummy for positive expenditures in housekeeping services, and the lower panel when the variable of interest is the level of expenditures in dollars. Several points are worth mentioning. First, all of the main effects of relative supply of low-skilled vs. high-skilled workers are negative (contrary to the predictions of the model), though none is statistically significant. On the other hand, the interaction with the dummy for wife or female head with a graduate degree is positive, large in magnitude, and, for the level of expenditures' equation, statistically significant at the 10 percent level. The magnitude of the coefficients suggests that the low-skilled immigration flow of the 1990s increased by a city-average of 6-9 dollars per quarter the amount spent on housekeeping services by households whose wife/female head has a graduate degree.[20] Given that women with a graduate degree reduced their time doing household work by 6.8 hours a quarter, 6-9 dollars seems a little low. There are two reasons why this number is not necessarily low: first, given that expenditures on housekeeping services do not include expenditures on services such as gardening, laundry, child-care (that are likely to be the first ones acquired from the market or provided by hired service), the estimated effect on expenditures is probably underestimating the real total effect on service acquisition on the market. Second, the estimations come from different datasets and hence are not necessarily comparable in magnitudes with the previous one. Therefore, we consider the number to be in a reasonable range, and see it as a confirmation that highly educated (skilled) women are indeed substituting, partially at least, household production with market services.

Combining the Cortés's (2006) price estimates with the estimates on expenditures from Table 2.12, we calculate a price elasticity of demand for housekeeping services between 2 and 3.

2.5.4 High-Skilled Women and Time Use

The empirical evidence we present in the previous subsections describes an interesting profile of response by highly-skilled women. We observe that while for women with a masters degree there is some negative effect on labor force participation, this effect is not significantly different from 0 for women with a professional degree. Interestingly, these same groups experience a large

the NHAPS survey and some compatibility concerns about the labor supply statistics lead us to present the results with the ATUS and PSID sample only.

[20]Given that the average expenditure for this group in 1990 was approximately 70 dollars, the estimated effect represent a 10 percent increase in expenditures.

effect on hours worked conditional on working, a result that implies that the women who work, work longer hours on average.[21] This effect may come in a variety of ways: women at the top may start working more or all working women may work more hours per week than women who worked before the waves of low-skilled immigration. The evidence in Table 2.9 suggests that part of this effect comes from an increased fraction of women working more than 50 and 60 hours per week. This effect is compatible with the fact that among the women with professional degrees we observe many occupations that require long hours of work (e.g. lawyers, physicians) or that have irregular schedules (e.g. nurses, physicians), making them more likely to rely on flexible services as replacement for household work.[22]

Further evidence can be observed in the middle and lower panels of Table 2.10. One main reason why households may need more household work is related to the presence of children, as looking after them and keeping them company are likely to be time consuming. In Table 2.10 we show that the response to immigration is larger when there is a child present at home, the estimated coefficient is positive and significantly different from 0. The magnitude of the coefficient suggests that the increase in the probability of working more than 50 and 60 hours per week is aproximately 30 to 60% larger than the increase for a woman without a child at home. In section 2.2 we mentioned that the valuation effect of the lower prices on non-labor income could play a role; evidence supporting this is presented in Table 2.10 also, where we see that the effect of low-skilled immigration is attenuated for women whose spouse (husband) holds a professional degree.

Overall, the picture observed in our empirical results suggests that the household production/time use decision is a reasonable channel for these responses to low-skilled immigration and their effects through reduced prices for services. The differential effects according to skill level (or educational attainment) are likely to be linked to an increase in the demand for these services; also women with more education are less likely to suffer a direct effect on their wages. The significant effect of household characteristics, in particular the effect of children, also points in the same direction.

[21] It is hard to interpret a regression like this as more than just a simple conditional mean. However, it is important because it hints that the distribution of hours might have shifted beyond the reduction in labor force participation.

[22] See Table B.2 for a list of the main occupations of women with a professional degree or a Ph.D.

2.6 Concluding Remarks

This chapter shows that low-skilled immigration into the US can generate effects on the labor supply of natives that go beyond the standard analysis of the impact that immigrants have on natives of similar skill. Using a simple model of time-use, we argue that by lowering the prices of services that are close substitutes of home production, low-skilled immigrants might increase the labor supply of highly skilled native women, a group that is unlikely to be affected through other channels usually mentioned in the literature: wages and employment (displacement) effects. It is particularly interesting that for the other groups of the population, we find no consistent evidence suggesting a channel through market services and time-use considerations (household production and labor supply).

Using Census data we estimate that the low-skilled immigration wave of the 1990s increased by 7 and 33 minutes a week, respectively, the time women with a master's degree or a professional degree spend working in the market. The effect is larger for highly educated women that have small children (38 minutes). The average increase hides important changes in the distribution of hours. Many women with professional degrees, especially lawyers, physicians, and women with Ph.D.'s, work in fields where long hours are required to succeed. Motivated by this fact we explore whether women in those groups effectively choose to work longer hours a week when the prices of services go down. We find that low-skilled immigration has helped professional women increase significantly their probability of working more than 50 and 60 hours. We also find that the effects of low-skilled immigration on these outcomes are stronger for women in households were there are children present, with estimates that imply an increase in the impact between 20 to 50% of that on a woman without children at home.

As supporting evidence for our result on the effects of low-skilled immigration on the labor supply of highly skilled women, we find that low-skilled immigration has also decreased the amount of time women with a graduate degree devote to household work and has increased the amount of services purchased in the market; a result that is implicit in their reported dollar expenditures in housekeeping services.

Our findings suggest that only women at the very top of the skill distribution are being positively affected by the reduction in the prices of services that are substitutes for household production. Therefore we provide additional support for the hypothesis that the effects of low-skilled immigration on the welfare of the native population can be heterogeneously distributed, benefitting some groups more than others. In our particular case we find that very highly educated women seem to be able to choose labor supply profiles that they could not afford before. The question remains open as to whether this allocation is indeed desirable if the quality of some of the goods, like childcare, is not the same when provided by the market instead of by the parents (Baker et al., 2005).

Additionally, the fact that highly-educated women change their labor supply decisions in response to the immigration-induced price changes also suggests that at least part of the differences between women and men in certain jobs reflect barriers that should not be fully attributed to differences in preferences; according to our results, part of these differences are coming from restrictions on affordable household help. Women might indeed value family life more than men, but the lack of more affordable services seems to be playing a role on the decision.

Finally, while on a broader perspective the estimated effects are not likely to be the main channel through which immigration affects natives, they do provide a newer point of view on the same question about the effects of immigration on native workers. Highlighting a plausible and new channel emphasizes the importance of a thorough understanding of the effects of immigration across all groups and not just for those that seem at first sight to be most affected by it. The high level of heterogeneity in the responses implies that the benefits are extremely concentrated at the top of the educational attainment distribution.

Table 2.1. Share of Low-skilled Immigrants in the Labor Force (%).

City	1980	1990	2000
Atlanta	0.38	0.84	3.23
Baltimore	0.76	0.44	0.67
Boston	3.53	2.71	2.62
Chicago	4.99	5.09	5.86
Cincinnati	0.44	0.23	0.34
Cleveland	1.82	0.89	0.65
Dallas	2.13	5.17	8.63
Denver	1.18	1.42	4.13
Detroit	1.76	0.93	1.35
Houston	3.96	7.03	9.21
Kansas City	0.58	0.47	1.44
Los Angeles	11.64	15.90	15.09
Miami	15.13	14.44	11.36
Milwaukee	1.07	0.84	1.54
Minneapolis	0.49	0.37	1.43
New Orleans	1.20	1.13	1.08
New York City	8.91	7.82	8.15
Philadelphia	1.39	0.91	1.06
Portland	1.03	1.53	3.27
St. Louis	0.49	0.24	0.53
San Diego	4.59	5.92	6.34
San Francisco	4.40	6.73	6.19
Seattle	1.22	1.00	1.94
Tampa	1.50	1.69	2.15
Washington DC	1.61	2.52	3.76

Source: US Census

Note: Low-skilled workers are defined as those without a high school degree

Table 2.2. Top Industries Intensive in Low-skilled Immigrant Labor (2000).

All Low-skilled Immigrants	% *	Male LS Immigrants	%	Female LS Immigrants	%
Labor Force	5.3	Labor Force	3.3	Labor Force	1.9
Textiles	44.8	Gardening	28.5	Textiles	27.9
Gardening	29.2	Shoe repair	19.2	Private households	25.8
Leather Products	28.4	Crop production	19.0	Leather products	16.1
Private households	27.4	Car washes	17.5	Fruit and veg. preserv.	13.1
Animal slaughtering	25.3	Textiles	16.9	Dry cleaning and laundry SS	12.0
Crop production	24.0	Animal slaughtering	16.5	Services to buildings	11.6
Fruit and veg. preserv.	21.9	Furniture manuf.	15.9	Sugar products	11.2
Car washes	20.2	Carpets manuf.	15.2	Animal slaughtering	8.8
Services to buildings	20.0	Recyclable material	12.7	Hotels	8.0
Carpets manuf.	19.8	Wood preservation	12.4	Pottery, ceramics	7.6
Furniture manuf.	19.8	Leather products	12.3	Nail salons	7.5
Sugar products	19.3	Construction	12.3	Home health care SS	6.7
Dry cleaning and laundry SS	19.3	Fishing, hunting	12.0	Plastics products manuf.	6.5
Shoe repair	19.2	Bakeries	11.9	Seafood	6.3
Bakeries	17.9	Aluminum prod.	11.8	Toys manufacturing	6.1

* % of LS Immigrants in Tot. Employment of Industry. Includes only the 25 largest cities.
Source: Census (2000)

Table 2.3. Descriptive Statistics - Census Data on Women's Labor Supply.

	High School Dropout			*High School Graduate*			*Some College*		
	1980	1990	2000	1980	1990	2000	1980	1990	2000
Share (% year-sample)	0.24	0.15	0.12	0.42	0.34	0.30	0.20	0.31	0.33
Labor Force Partipation	0.46 (0.50)	0.48 (0.50)	0.47 (0.50)	0.63 (0.48)	0.67 (0.47)	0.65 (0.48)	0.67 (0.47)	0.76 (0.43)	0.75 (0.43)
Usual Weekly Hrs. Market Work | H>0	34.62 (11.30)	34.85 (11.72)	35.35 (12.04)	35.20 (10.38)	35.86 (10.62)	36.71 (10.81)	34.39 (11.23)	35.71 (11.17)	36.32 (11.52)
% work $\geq$ 50 hrs.	0.02 (0.13)	0.03 (0.17)	0.03 (0.18)	0.03 (0.18)	0.06 (0.23)	0.07 (0.26)	0.04 (0.20)	0.08 (0.26)	0.09 (0.29)
% work $\geq$ 60 hrs.	0.01 (0.09)	0.01 (0.11)	0.01 (0.12)	0.01 (0.11)	0.02 (0.15)	0.03 (0.16)	0.01 (0.12)	0.03 (0.16)	0.03 (0.17)
Married	0.59 (0.49)	0.52 (0.50)	0.50 (0.50)	0.65 (0.48)	0.60 (0.49)	0.56 (0.50)	0.55 (0.50)	0.54 (0.50)	0.53 (0.50)
Child $\leq$ 5	0.15 (0.36)	0.17 (0.37)	0.17 (0.38)	0.17 (0.38)	0.17 (0.37)	0.15 (0.35)	0.16 (0.37)	0.17 (0.38)	0.15 (0.36)
Child $\leq$ 17	0.40 (0.49)	0.37 (0.48)	0.39 (0.49)	0.44 (0.50)	0.39 (0.49)	0.38 (0.48)	0.38 (0.49)	0.39 (0.49)	0.38 (0.49)

	College Grad			*Master's Degree*			*Professional Degree or Ph.D.*		
	1980	1990	2000	1980	1990	2000	1980	1990	2000
Share (% year-sample)	0.07	0.14	0.17	0.06	0.05	0.06	0.01	0.01	0.02
Labor Force Partipation	0.72 (0.45)	0.81 (0.39)	0.79 (0.41)	0.79 (0.41)	0.87 (0.33)	0.85 (0.36)	0.85 (0.36)	0.88 (0.32)	0.86 (0.34)
Usual Weekly Hrs. Market Work | H>0	35.61 (11.18)	37.49 (11.27)	38.55 (11.74)	35.62 (11.22)	38.67 (11.05)	40.02 (11.72)	38.08 (12.44)	41.24 (13.43)	42.39 (13.91)
% work $\geq$ 50 hrs.	0.06 (0.24)	0.12 (0.33)	0.17 (0.37)	0.06 (0.23)	0.14 (0.35)	0.19 (0.40)	0.15 (0.36)	0.27 (0.46)	0.32 (0.47)
% work $\geq$ 60 hrs.	0.02 (0.14)	0.04 (0.19)	0.05 (0.22)	0.02 (0.13)	0.04 (0.20)	0.06 (0.24)	0.06 (0.23)	0.11 (0.32)	0.14 (0.35)
Married	0.66 (0.47)	0.61 (0.49)	0.62 (0.49)	0.59 (0.49)	0.61 (0.49)	0.62 (0.48)	0.52 (0.50)	0.59 (0.49)	0.61 (0.49)
Child $\leq$ 5 yrs.	0.19 (0.39)	0.18 (0.39)	0.18 (0.38)	0.16 (0.36)	0.15 (0.36)	0.14 (0.34)	0.11 (0.32)	0.18 (0.38)	0.16 (0.37)
Child $\leq$ 17 yrs.	0.41 (0.49)	0.37 (0.48)	0.39 (0.49)	0.36 (0.48)	0.36 (0.48)	0.35 (0.48)	0.28 (0.45)	0.35 (0.48)	0.37 (0.48)

Table 2.4. Descriptive Statistics - Time-use of Women from 1980 PSID and 2003-2005 ATUS.

	High School Drop		*High School Grad*		*Some College*	
	1980	2000s	1980	2000s	1980	2000s
Sample Share	0.22	0.12	0.31	0.29	0.32	0.29
Avg. Hours/week spent on HHld. Chores	25.05 (17.12)	17.96 (17.12)	24.52 (16.13)	15.09 (15.80)	22.19 (15.96)	13.82 (15.36)
Avg. Hours/week spent on HHld. Chores, male	7.97 (9.06)	5.50 (10.27)	7.73 (7.73)	6.54 (6.54)	36.98 (8.77)	36.85 (10.64)
Usual Hours/week market work | H>0	36.87 (10.81)	35.35 (10.62)	36.65 (8.35)	37.14 (9.88)	7.61 (6.94)	6.51 (10.93)
Labor Force Partipation	0.50 (0.50)	0.49 (0.50)	0.60 (0.49)	0.72 (0.45)	0.71 (0.46)	0.75 (0.43)
Married	0.53 (0.50)	0.47 (0.50)	0.75 (0.44)	0.55 (0.50)	0.67 (0.47)	0.51 (0.50)
Child less than 6 years	0.31 (0.46)	0.27 (0.45)	0.40 (0.49)	0.21 (0.41)	0.33 (0.47)	0.20 (0.40)
Children	0.65 (0.48)	0.52 (0.50)	0.71 (0.46)	0.48 (0.50)	0.59 (0.49)	0.50 (0.50)

	College Grad		*More than College*	
	1980	2000s	1980	2000s
Sample Share	0.11	0.21	0.04	0.11
Avg. Hours/week spent on HHld. Chores	20.40 (14.83)	13.38 (13.66)	16.85 (13.57)	11.66 (12.69)
Avg. Hours/week spent on HHld. Chores, male	7.92 (6.53)	6.88 (10.76)	6.67 (6.23)	7.40 (11.16)
Usual Hours/week market work | H>0	36.95 (8.82)	37.50 (12.00)	35.24 (10.92)	40.03 (11.67)
Labor Force Partipation	0.72 (0.45)	0.78 (0.42)	0.89 (0.31)	0.83 (0.38)
Married	0.75 (0.44)	0.63 (0.48)	0.79 (0.41)	0.63 (0.48)
Child less than 6 years	0.32 (0.47)	0.26 (0.44)	0.25 (0.44)	0.25 (0.43)
Children	0.46 (0.50)	0.52 (0.50)	0.43 (0.50)	0.50 (0.50)

Table 2.5. Descriptive Statistics - Consumer Expenditure Survey.

Education of Woman (spouse or head)	1980	1990	2000
	High School Dropout		
Sample Share	0.18	0.12	0.07
Dummy for Positive Exp. in Housekeeping	0.03 (0.16)	0.03 (0.17)	0.03 (0.17)
Housekeeping Expenditures (1990 dollars)	2.06 (22.74)	3.83 (24.73)	4.56 (30.63)
	High School Grad		
Sample Share	0.39	0.35	0.29
Dummy for Positive Exp. in Housekeeping	0.05 (0.21)	0.03 (0.18)	0.03 (0.17)
Housekeeping Expenditures (1990 dollars)	9.28 (75.02)	8.52 (88.72)	4.79 (50.42)
	Some College		
Sample Share	0.25	0.28	0.32
Dummy for Positive Exp. in Housekeeping	0.07 (0.26)	0.09 (0.29)	0.07 (0.25)
Housekeeping Expenditures (1990 dollars)	14.54 (81.40)	18.36 (83.40)	11.01 (57.69)
	College Grad		
Sample Share	0.11	0.15	0.21
Dummy for Positive Exp. in Housekeeping	0.16 (0.37)	0.15 (0.35)	0.15 (0.35)
Housekeeping Expenditures (1990 dollars)	80.51 (312.33)	37.69 (135.08)	35.67 (131.26)
	More than College		
Sample Share	0.08	0.10	0.10
Dummy for Positive Exp. in Housekeeping	0.18 (0.38)	0.22 (0.41)	0.26 (0.44)
Housekeeping Expenditures (1990 dollars)	77.94 (362.03)	63.75 (192.59)	103.24 (469.74)

Table 2.6. Origin of Low-skilled US Immigrants.

	Top Sending Countries	% Tot. LS Immigrants	Top Sending Countries	% Tot. LS Immigrants
Rank	*1970**		*1980*	
1	Mexico	15.19	Mexico	46.14
2	Italy	13.40	Cuba	3.69
3	Canada	9.61	Portugal	3.51
4	Germany	6.53	Italy	3.01
5	Cuba	6.43	Philippines	2.77
Rank	*1990*		*2000*	
1	Mexico	53.54	Mexico	64.01
2	El Salvador	5.22	El Salvador	4.93
3	Cuba	3.63	Guatemala	3.90
4	Italy	2.78	Vietnam	2.89
5	China	2.33	Honduras	2.45

* The numbers for 1970 represent the composition of the stock of LS immigrants, and the numbers for 1980-2000 represent the composition of the decade flows.

Source: US Census.

Table 2.7. First Stage.

	(1)	**(2)**	**(3)**
Instrument*	0.10	0.09	0.23
	(0.02)	(0.02)	(0.04)
Dataset	Census	PSID-ATUS	CEX
Includes 1990	Yes	No	Yes
No. Obs.	315	203	108

* Dependent Variable: ln(Ag. LS Labor/HS Labor). Instrument is given in equation (2.14).

Note: OLS estimates. City and region*decade fixed effects are included in all the regressions. Robust std. errors are reported in parenthesis.

Table 2.8. The Effect of Low-skilled Immigration on Women's Labor Supply by Education Group, Intensive and Extensive Margins. Each number in the tables comes from a different regression, where the explanatory variable of interest is the relative labor supply of low-skilled vs. high-skilled workers, appropriately instrumented with low skilled immigration (see equation (2.14)). The sample is restricted to a given education group.

	Dependent Variable					
Education Level of Woman	*Usual Hrs. Work | Working*			*LF Participation*		
	OLS	IV	N. obs	OLS	IV	N. obs
High School Drop	-0.03	-1.26	355394	-0.026	-0.087	926170
	(0.30)	(1.04)		(0.014)	(0.044)	
High School Grad	0.27	0.15	1251652	-0.045	-0.168	1767763
	(0.22)	(0.51)		(0.014)	(0.049)	
Some College	0.16	0.84	1168804	-0.011	-0.100	1435280
	(0.22)	(0.55)		(0.010)	(0.034)	
College grad	0.10	1.03	560964	-0.017	-0.115	667724
	(0.25)	(0.60)		(0.009)	(0.028)	
Master degree	0.27	1.66	243499	-0.02	-0.102	276244
	(0.29)	(0.76)		(0.09)	(0.024)	
Professional Degree	1.25	7.78	74456	-0.009	-0.035	83238
	(0.68)	(2.16)		(0.012)	(0.026)	

*See text for characteristics of the sample. All regressions include city and region*decade fixed effects, and demographic controls (age, age squared, marital status, race, children). Standard errors are clustered at the city*decade level.

Table 2.9. The Effect of LS Immigration on Women's Probability of Working Long Hours by Education Group (Census Data). Each number in the table comes from a different regression, where the explanatory variable of interest is the relative labor supply of low-skilled vs. high-skilled workers, appropriately instrumented with low skilled immigration (see equation (2.14)). The sample is restricted to a given education group.

	Dependent Variable			
Education Level of Woman	Pr($hrswork \geq 50$)		Pr($hrswork \geq 60$)	
	Unconditional	Cond. on working	Unconditional	Cond. on working
	IV	IV	IV	IV
High School Drop	-0.002	0.012	0.003	0.013
	(0.009)	(0.017)	(0.006)	(0.012)
High School Grad	0.006	0.017	0.008	0.014
	(0.007)	(0.008)	(0.004)	(0.006)
Some College	0.021	0.028	0.002	0.003
	(0.009)	(0.010)	(0.004)	(0.005)
College grad	0.091	0.104	0.026	0.029
	(0.022)	(0.025)	(0.011)	(0.012)
Master Degree	0.102	0.122	0.023	0.027
	(0.026)	(0.030)	(0.011)	(0.013)
Professional Degree	0.232	0.272	0.074	0.088
	(0.066)	(0.074)	(0.039)	(0.043)

*See text for characteristics of the sample. All regressions include city and region*decade fixed effects and demographic controls (age, age squared, marital status, race, children). Standard Errors are clustered at the city*decade level.

Table 2.10. LS Immigration and the Labor Supply of Highly Educated Women: Effects of Children and Highly Educated Husbands (Census Data). Each number in the table comes from a different regression, where the explanatory variable of interest is the relative labor supply of low-skilled vs. high-skilled workers, appropriately instrumented with low skilled immigration (see equation (2.14)). The sample is restricted to women with a professional degree or Ph.D.

	Dependent Variable		
Explanatory Variable	Usual Hrs. Worked $\mid H > 0$		
$\ln(AggLS/HSLabor)$	6.36	6.96	7.00
	(2.32)	(2.12)	(2.02)
$\ln(AggLS/HSLabor)$ interacted with dummy for:			
Child age < 6	2.77		
	(0.85)		
Dummy for Child age < 18		1.81	
		(0.57)	
Husband with Professional Degree			-0.435
			(0.68)
	$\Pr(hrswork \geq 50 \mid H > 0)$		
$\ln(AggLS/HSLabor)$	0.313	0.247	0.252
	(0.086)	(0.073)	(0.067)
$\ln(AggLS/HSLabor)$ interacted with dummy for:			
Child age < 6	0.050		
	(0.023)		
Dummy for Child age < 18		0.055	
		(0.019)	
Husband with Professional Degree			-0.053
			(0.018)
	$\Pr(hrswork \geq 60 \mid H > 0)$		
$\ln(AggLS/HSLabor)$	0.092	0.075	0.072
	(0.052)	(0.043)	(0.037)
$\ln(AggLS/HSLabor)$ interacted with dummy for:			
Child age < 6	0.039		
	(0.018)		
Dummy for Child age < 18		0.030	
		(0.014)	
Husband with Professional Degree			-0.029
Degree			(0.014)

*See text for characteristics of the sample. All regressions include city and region*decade fixed effects and demographic controls (age, age squared, marital status, race, children). Standard Errors are clustered at the city*decade level.

Table 2.11. The Effect of Low-skilled Immigration on Time Devoted to Household Work by Education Group (PSID and ATUS Data). Dependent variable is usual hours per week devoted to household work, and the explanatory variable of interest is the relative labor supply of low-skilled vs. high-skilled workers, appropriately instrumented with low skilled immigration (see equation (2.14)). Each column on each panel corresponds to a separate regression; identification of effects by education group comes from the interaction of the dependent variable and a dummy for the corresponding group.

Panel (a). Women.

	All women (n=11657)			Women working (n= 6031)		
Explanatory Variable	OLS	IV	IV	OLS	IV	IV
ln($AggLS/HSLabor$)	7.00	12.91		0.40	5.65	
	(2.54)	(6.98)		(1.40)	(4.50)	
ln($AggLS/HSLabor$) interacted with a dummy for:						
High School Drop			19.21			5.15
			(7.76)			(7.59)
High School Grad			15.07			9.45
			(6.67)			(4.75)
Some College			9.01			2.40
			(6.84)			(4.79)
College			11.52			7.09
			(6.93)			(4.90)
More than College			-8.29			-12.98
			(4.30)			(4.89)

Panel (b). Men.

	All men (n=9045)			Men working (n= 6218)		
Explanatory Variable	OLS	IV	IV	OLS	IV	IV
ln($AggLS/HSLabor$)	-0.60	-3.88		-0.83	-3.42	
	(1.22)	(3.56)		(1.08)	(2.88)	
ln($AggLS/HSLabor$) interacted with a dummy for:						
High School Drop			-5.90			-5.16
			(4.62)			(4.02)
High School Grad			-4.79			-3.76
			(3.95)			(3.15)
Some College			-4.36			-4.99
			(4.00)			(3.39)
College			-2.49			-2.60
			(3.89)			(3.14)
More than College			-4.43			-3.79
			(3.31)			(2.87)

*See text for characteristics of the sample. All regressions include city and region*decade fixed effects and demographic controls (see text). Standard Errors are clustered at the city*decade level.

Table 2.12. Low-skilled Immigration and the Consumption of Housekeeping Services (CEX data 1980-2000). Each column for each dependent variable corresponds to a separate regression. The explanatory variable of interest is the relative labor supply of low-skilled vs. high-skilled workers, appropriately instrumented with low skilled immigration (see equation (2.14)).

	Dependent Variable			
	Dummy for Positive Expenditure			
Explanatory Variable	OLS	IV	OLS	IV
$\ln(AggLS/HSLabor)$	-0.084	-0.041	-0.082	-0.038
	(0.027)	(0.062)	(0.027)	(0.061)
$\ln(AggLS/HSLabor)$ interacted with a dummy for:				
Women with graduate degree			-0.028	0.119
	(0.032)	(0.111)		
	Expenditures (in US$)			
	OLS	IV	OLS	IV
Log(LS Labor Aggregate/HS Labor)	-63.21	-48.58	-64.01	-45.67
	(14.25)	(37.45)	(14.35)	(36.68)
$\ln(AggLS/HSLabor)$ interacted with a dummy for:				
Women with graduate degree			12.42	127.51
	(25.41)	(72.90)		

*See text for characteristics of the sample, total number of observations is 9109. All regressions include city and region*decade fixed effects and demographic controls (see text). Standard Errors are clustered at the city*decade level.

Chapter 3

Trade in Goods and International Teams in a Model of Trade with Heterogeneous Agents[1]

3.1 Introduction

For almost 20 years, both researchers and policymakers on international trade have been paying attention to the fast growth of trade in intermediate inputs, as well as to multinational firms, and the increasing fragmentation of the production process (with the final good produced with small parts of value added coming from different locations). The latest incarnation of this movement is the increasing relevance of trade in services, i.e. situations where production may involve little or no movement of intermediate goods, but where different activities needed to produce some final (or intermediate good) are carried out without being geographically close.

Although no direct evidence exists on the extent of this "disintegration" process, there are many indications that it is (rapidly) growing. For example, intra-firm trade accounted for almost 50% of US total imports, most of it associated with the division of production inside multinationals firms. Moreover, trade in Business, Professional and Technical services has grown extremely fast recently, suggesting that the process is also affecting sectors where most of the value added is not necessarily reflected in physical goods.[2] There also is evidence that offshoring is not exclusive of the US only, for example Marin (2006) presents evidence of Austrian and German firms outsourcing

[1]I thank George-Marios Angeletos and Olivier Blanchard for their comments.

[2]See Grossman and Rossi-Hansberg (2006, 2008) and the references therein.

and offshoring production to Eastern European countries.

One important feature of the production process is that it entails the work of many different units and/or workers that participate in different stages of the process or produce different parts of the final product. While intermediate inputs can partially capture this process, the particular characteristics of these teams are likely to be determined in equilibrium, and changes in the international organization of production are associated with changes in the team formation process. For example, the reduction in trade and communication costs in recent decades has certainly allowed firms to separate production in ways that were not viable before. We now have the possibility to send electronic copies of reports overseas, to answer questions by phone from a different continent and to ship abroad goods that were not tradable before. In this sense, borders are likely to become less relevant as a barrier to production and organization decisions.

This reduction in trade and communication costs has allowed firms and teams to be organized across borders, hence, allowing particular organizations and combinations that were not feasible before. As a consequence, it improves upon the preexisting set of possible teams and matches. Traditional trade in goods has the potential to generate similar effects: by changing relative prices it also changes incentives to allocate in different sectors, and the characteristics of teams in each of them. This chapter thus explores the potential effects of international team formation in a context where there is trade in final goods and where production is carried out in teams comprised of agents that differ along a single characteristic.

Overview. To study the effects of the fragmentation process this chapter extends the "diversity and trade" framework introduced by Grossman and Maggi (2000) by allowing offshoring via the formation of international production teams. In this model there are two sectors and a continuum of agents that are heterogeneous along a single dimension, for simplicity I will call it *talent.* These agents work in teams producing one of two goods, C and S; teams require two agents to produce, each agent performs a task that is essential. Following Grossman and Maggi (2000), I assume that good C's production is such that there are complementarities between the characteristics of the agents. On the other hand, tasks are substitutes in the production of good S. These differences in production lead to differences in the relative valuation of alternative team compositions between sectors.

With heterogeneous agents and team formation in each of the two sectors, production decisions require the formation of teams and the assignment of the members to the corresponding tasks or stages. Therefore, matching, in the sense of finding the most appropriate partner, and sorting, finding the sector to participate in, are the elements that determine the aggregate outcome of the economy. When the world is separated into many countries, national borders limit the pairings that can be done and reduce the allocation set of the economy.

Before studying the effects of trade and globalization, this chapter describes the matching and sorting patterns for each sector and for the whole economy following Grossman and Maggi (2000) and Legros and Newman (2002). Starting from the integrated equilibrium benchmark, we introduce globalization into two different steps. First, the world is separated in two countries. Second, international teams are introduced into the equilibrium with free trade in goods. Without any restriction on matchings that can be formed and with costless shipping of goods, the economy achieves the integrated equilibrium. I find a condition on the countries' talent distributions under which trade in goods does replicate the integrated equilibrium. It is then possible to show that free trade in goods does not necessarily replicate the integrated equilibrium.

The main message of this chapter is that in the class of models under study, international teams have the potential to generate efficiency gains beyond what can be achieved from pure trade in goods and, furthermore, these gains seem to be the general case.[3] Unlike models with fixed intensities and without teams, in this chapter this result arises because international teams allow the economy to utilize different team configurations not achievable when matches are restricted to happen within countries, hence expanding production and consumption opportunities. In equilibrium, the changes in the set of teams that are available lead to changes in the talent intensity of the teams producing in each one of the sectors, i.e., the specific pairings observed in the different sectors are endogenously determined.[4]

Related Literature. This study is related to several strands of the literature on the effects of international trade on domestic labor markets. First, this work contributes to the literature on offshoring and team formation. The two more relevant papers in this literature are Kremer and Maskin (2003) and Antras, Garicano and Rossi-Hansberg (2006). Kremer and Maskin (2003) present a two-country model with one good where labor is the sole production factor and workers are heterogeneous along a single dimension, skill. The good is produced by 2-person teams with each agent performing a different task, one of the two tasks is more sensitive to skill level. They

[3]While I interpret the model as representing international teams, there are other means to achieve the same effect in terms of expanding the production possibility frontier, e.g. immigration.

[4]Grossman and Rossi-Hansberg (2008) also allow for skill intensity to respond to fragmentation, but it is done in a context without team formation.

show that under certain circumstances, when international teams are a possibility, inequality may increase both in more developed and less developed countries. The work by Antras et al. (2006) uses a micro-founded model of hierarchies that allows for one-to-many matchings (i.e., teams can have more than two members and the exact number is an equilibrium outcome) and two layers (managers and workers) to endogenously determine the team formation patterns and the particular task taken up by each type of agent.[5] They study the effects of offshoring on sorting patterns and wages when managers and workers can be in different countries whose skill distributions do not fully overlap.[6] While these two papers explicitly study the effects of international team formation on wages and sorting, their single good assumption implies that trade in goods is not feasible unless there is trade in services, and even then goods can only flow in one direction unless bidirectional trade in the same good is allowed. Although the authors do not focus on the result, in their models the competitive equilibrium without international teams need not replicate the integrated equilibrium, a result that is also present in this chapter.

This chapter is also related to the work by Grossman and Maggi (2000). The model in this chapter borrows their set-up presenting a model where there are heterogenous agents that work in teams and there are two sectors that differ in the valuation of combined talents. In their paper differences across countries in the "diversity" of the talent distributions generate a pattern of comparative advantage that leads to interindustry trade among countries with the same average endowment levels. While the model is essentially the same, this work explores a different issue, which is the incremental role played by international teams in a context where there is sorting and where trade in goods itself generates patterns of comparative advantage.

Grossman (2004) and Ohnsorge and Trefler (2007) also study models of trade with heterogenous agents in many sectors. Ohnsorge and Trefler (2007) consider an economy where agents differ along two different characteristics and sectors differ in their intensity with respect to each one of these characteristics. In equilibrium, agents endogenously sort into different sectors and differences in higher moments in the distribution of characteristics then translate into comparative advantage. Grossman (2004) considers a model with agents that differ along a single characteristic and where production in one of the sectors is carried out by teams; the focus there is on the interaction of incomplete contracts (because of unobservable characteristics) and international trade, and how

[5]See Antras, Garicano and Rossi-Hansberg (forth.) for a version where they allow for middle managers and extra costs associated with the set-up of international teams.

[6]The overlap is an inverse measure of "similarity" in their case: the higher the overlap, the smaller the difference between the highest skill levels in the two countries and the more similar the density of the skill distributions for each of the skill levels.

the latter magnifies the effects of incomplete contracts. However, they do not study the effects of international teams.

Finally, the work presented here is related to the recent literature on the effects of falling costs of offshoring when production can be fragmented and part of it can be offshored. Two recent papers on this literature are Rodriguez-Clare (2007) and Grossman and Rossi-Hansberg (2008). While their models do allow incremental effects of offshoring in the presence of trade in goods, their production frameworks do not incorporate production in teams. Thus, there is no matching in the sense of endogenously choosing the best combination of talent levels for production of each good neither there is endogenous sorting of heterogeneous agents into different sectors (goods).

Outline. The rest of the chapter is organized as follows. In section 3.2 I present the model, first introduced in Grossman and Maggi (2000), and characterize the equilibrium in a closed economy (the integrated equilibrium) and with free trade in goods. Section 3.3 introduces international teams and presents a condition under which the two-country economy with free trade in goods can replicate the integrated equilibrium. The main conclusions and some final remarks are presented in section 3.4.

3.2 Model

3.2.1 Set-up

The basic elements of the model are as in Grossman and Maggi (2000), the results that will be used later are presented in this section. Throughout the chapter I assume markets are competitive and there are no search frictions in factor markets.

Agents. Preferences are assumed to be homothetic over the two goods, C and S, and all agents have the same preferences. Agents differ on their talent level t, which we assume to be observable. The talent distribution is given by a cdf $\Phi(t)$ with support $[\underline{t}, \overline{t}]$, $\underline{t} > 0$, and associated pdf $\phi(t)$, which I assume to be continuous; denote by t_m and $\widetilde{t}$ the median and the mean, respectively, of this distribution. Agents are endowed with one unit of labor that they supply inelastically in the market. Talents are neither sector nor task specific, implying that in equilibrium all agents with the same talent level will receive the same wage. In some cases I will assume that the pdf $\phi(t)$ is symmetric, this simplifies the results and also allows me to stay closer to the original Grossman and Maggi (2000) framework.

Production. Production in both sectors is done by teams, that perform two tasks, a and b, both of them are indivisible and essential for production. Each team is formed by two agents, each of them is assigned to a single task (each task is performed by one agent). The production functions exhibit constant returns to talent. The structure of production implies there are two "parts" in the allocation process. First, agents are allocated to different sectors, process which I refer to as *sorting*. Second, they must join with a partner of a certain talent level, which I refer to as *matching*. In equilibrium this process determines the effective productive capacity. We will assume that there are no frictions, hence the search and matching process is costless.

The sectors differ according to the relation between the two tasks in the production process. Let us denote by $F^i(t_a, t_b)$ the production function in sector i, where t_a and t_b correspond to the talent levels of the agents in each task. We assume that in sector S, tasks are substitutes to each other, in the sense that the production function is submodular, which implies that $F^S_{ab} \geq 0$, where the subindex ab indicates that is the second derivative of the production function with respect to the talent level in tasks a and b. On the other hand, we assume tasks are complements in teams in sector C, in particular we assume that F^C is supermodular, i.e. $F^C_{ab} \leq 0$. This is summarized in the following statement.

Assumption 3.1 *Let $F^i(t_a, t_b)$ be the production function of a team conformed by one agent of talent t_a and another of talent t_b in sector $i = C, S$. Assume that $F^S(\cdot)$ is submodular and $F^C(\cdot)$ is supermodular. Also, assume the tasks in both sectors are symmetric, i.e. $F^i(t_a, t_b) = F^i(t_b, t_a)$.*

The assumption on the submodularity and supermodularity of the production function has clear implications for the matching of agents in the sector. While the matching patterns they imply are somewhat extreme, the assumptions also simplify the description and the supermodularity assumption has been used to describe certain production process (see (Kremer, 1993) for example). I also choose to present the results with these assumptions in order to stay close to the original results of Grossman and Maggi (2000), both for comparability and to simplify derivations.[7]

Lemma 3.1 (Within sector allocation) *Denote by $\Phi^j(t)$ the cdf of talent allocated to a sector j with production function $F^j(\cdot)$. Then,*

[7]See also the work by Legros and Newman (2002) for a more detailed analysis of monotone matching in frictionless matching models.

1. *if $F^j(\cdot)$ is supermodular, then the allocation that maximizes production is characterized by "segregation, i.e. agents of the same talent level work together.*

2. *if $F^j(\cdot)$ is submodular, then the allocation that maximizes production is an agent of talent t is matched up with an agent of talent level $m^j(t)$, where $m^j(t)$ is implicitly defined in $\Phi^j(m^j(t)) = (1 - \Phi^j(t))$. This allocation corresponds to a negative assortative matching result.*

Proof. See Propositions 3 and 7 in Legros and Newman (2002) and Lemmas 1 and 2 in Grossman and Maggi (2000). ■

Assumption 3.1 and Lemma 3.1 imply that in sector C (supermodularity) each agent matches with one of the same talent level. Under the assumption of supermodularity, there are no gains for the teams to try to match people with different talent levels, as production can be increased if we rearrange them into teams with equal talent levels. [8]

In sector S (submodularity), the opposite happens, decreasing the partner's talent level increases the marginal product, and in aggregate firms can increase production by trying to match agents with talent levels as dissimilar as possible. Thus, the emergence of negative assortative matching.

Equilibrium Allocation

The results from lemma 3.1, which describe the matching within sectors, can be used now to obtain the efficient allocation of agents across sector, i.e. the sorting or occupational choice. Both results together determine the production possibility frontier and the marginal rate of transformation of this economy. We focus on the efficient allocation as a way to characterize of the competitive allocation.[9]

We already know the matching of agents within each group for a given allocation of talent. We now need to find the sorting of agents to each sector. The following lemma shows the way in which agents sort into each sector. Agents in the tails of the distribution of talent will work in the S sector, while the rest works in sector C; the matching in each sector is according to Lemma 3.1.

Lemma 3.2 *For any point (Y^S, Y^C) on the production frontier we have that all agents of talent $t \leq \hat{t}$ and all agents of talent $t \geq m(\hat{t})$ are producing in sector S. The relation $m(t)$ is defined*

[8] One extreme form of supermodular function corresponds to $F = \min\{t_1, \ldots, t_n\}$, where total production depends only on the lowest level of talent assigned to production. The O-Ring model in Kremer (1993) is another example of a supermodular production function.

[9] See Grossman and Maggi (2000) for an explanation about the existence of a competitive equilibrium that maximizes output value in an economy like this.

implicitly by

$$\Phi(m(t)) = 1 - \Phi(t) \tag{3.1}$$

The cutoff value $\hat{t}$ *solves*

$$Y^S = \int_{\underline{t}}^{\hat{t}} F^S[t, m(t)]\,\phi(t)dt, \tag{3.2}$$

and production of good C *is given by*

$$Y^C = \frac{\lambda}{2}\int_{\hat{t}}^{m(\hat{t})} t\phi(t)\,dt, \tag{3.3}$$

where $\lambda \equiv F^C(1,1)$.

Proof. See Grossman and Maggi (2000). ■

The intuition for this result relies on the matching patterns stated before. Suppose we start from a situation where all agents are allocated in the production of good C. Starting from this point, separating the teams formed by the minimum and maximum talent agents and rematching them results in the units of S being produced at the minimum cost in terms of foregone units of good C. Notice also, that now the matching pattern in sector S is defined in terms of the economywide distribution $\Phi(t)$. Equation (3.3) follows from the fact that only agents with talent levels between $\hat{t}$ and $m(\hat{t})$ work in this sector and the matching pattern described in lemma 3.1. More importantly, as argued by Grossman and Maggi (2000), there exists a competitive equilibrium and it maximizes the value of output at current prices, thus implying efficiency in production. The results we just reviewed then characterize the competitive equilibrium too.

It turns out that when the distribution of talent is symmetric we can get a simpler characterization of the results, so we will use it later in some examples. Specifically, the matching pattern can be written in closed form without using the cdf.

Corollary 3.1 *If* $\phi(t)$ *is a symmetric function, then the matching rule in sector* S *is given by* $m(t) = 2t_m - t$, *where* t_m *corresponds to the median (and mean) talent level.*

3.2.2 Free Trade in Goods: the Diversity and Trade Result

Let us now think of the world as being composed of two countries: home and foreign, each of them populated by a mass one of agents and with access to the same technologies. Home and foreign quantities are denoted by a subscript H and F. In order to simplify the presentation assume that the world has a continuum of mass 2 of agents; the fraction of agents of each talent is given by $\phi(t)$, and we assume the cdf $\Phi(t)$ satisfy the same properties as before. Workers in each country differ along the same single characteristic as before, we assume each country is of the same size, i.e. both are populated by a continuum of mass 1 of heterogeneous agents. Let $\Phi_i(t)$ denote the distribution of talent in country $i = H, F$. In order to simplify the derivations we also assume that both talent distributions, $\Phi_H(t)$ and $\Phi_F(t)$, are continuously differentiable everywhere, and denote the corresponding pdf's by $\phi_H(t)$ and $\phi_F(t)$.

Trade in goods will affect the matches through prices, which change the relative demand for both goods and this induce a reallocation of agents; overall the transmission is similar to a Heckscher-Ohlin/factor endowments framework, with the difference that in this case it is not just about reallocating resources across sectors, but also changing the matching patterns within a sector (the S sector in this model). This extra element coming from the matching patterns also lies at the heart of the main result in this chapter.

In an equilibrium with free trade in goods the marginal rates of transformation are equalized across countries.[10] It turns out that in this case the cutoff $\hat{t}$ also defines the marginal rate of transformation, $\xi_i(\hat{t})$. Notice that for any of the countries $\xi(\hat{t})$ is given by

$$\xi(\hat{t}) = -\frac{dY^S/d\hat{t}}{dY^C/d\hat{t}} = 2\frac{F^S\left(\hat{t}, m\left(\hat{t}\right)\right)}{\lambda\left(\hat{t} + m\left(\hat{t}\right)\right)}, \tag{3.4}$$

where $\lambda \equiv F^C(1,1)$ is the per unit of talent production in equilibrium in sector C and $m(\cdot)$ is based on the distribution function of the particular country. Consider first the extreme cases when the country specializes in producing one of the goods; first, when $\hat{t} = \underline{t}$ we have $Y^S = 0$ and ξ reaches its maximum value. Second, if $\hat{t} = t_m$, then $Y^C = 0$ and ξ reaches its minimum value. Moreover, it is possible to show that[11]

$$\frac{\partial \xi(\hat{t})}{\partial \hat{t}} < 0 \quad \forall t \in \left(\underline{t}, t_m\right). \tag{3.5}$$

Grossman and Maggi (2000) note that the shape of the distributions Φ_i, in particular what they call "diversity", is related to the shape of the production possibility frontier. Intuitively, a

[10]Throughout this chapter we assume that countries do not fully specialize; this is a restriction on how dissimilar the countries can be, but none of the results hinge on this particular assumption.

[11]See appendix C.1.1 for a full proof of this result. The proof uses the assumptions of super and submodularity and constant returns to scale of the production functions, and the fact that

$$\frac{\partial m}{\partial \hat{t}} = -\frac{\phi(\hat{t})}{\phi\left(m(\hat{t})\right)}.$$

country with a more diverse distribution has the possibility of creating more matches between agents with very dissimilar talents, and these are the most productive teams in sector S, thus, it has an advantage in the production of this good. When countries open up to trade, this advantage induces a pattern of trade, which arises even if the average talent levels of the countries are the same.

3.3 International Teams

3.3.1 Incentives to Engage in International Teams

Let us move now to the case when agents can partner with agents in other countries, and the teams can sell their goods in any country.[12] It is intuitive to see that the equilibrium without barriers to trade in goods and to international teams replicates the integrated equilibrium: agents behave as if the world were just one single economy. Hence, we can characterize the integrated equilibrium as a closed economy with a distribution $\Phi(t)$ and with size 2, as in section 3.2.2.

However, we are interested in knowing conditions under which the formation of international teams is redundant, in the sense that costless trade in goods between the two countries replicates the integrated equilibrium. Given the structure of the economy, we know that only sector S can be affected by restrictions on the formation of teams; production of C always works with segregated matches, which are always feasible within a country. Let us focus on the S sector now, as we know this is the sector where the matches will show diversity. The two-country, free trade equilibrium requires the marginal rates of transformation to be equalized; then the free trade equilibrium replicates the integrated economy if, at the integrated economy's equilibrium price, it produces the same amount of goods S and C. Alternatively, if starting from the free trade equilibrium there are incentives for international teams to be created, then we know that equilibrium was not the most efficient one.

In order to generate the same equilibrium, the exact same matches in the S must be generated both in the integrated equilibrium and in the free trade equilibrium. The following condition guarantees that those matches are feasible in the new equilibrium.

[12] Instead of assuming the cost of creating an international team is 0, I assume that it is infinitesimal but positive, thus formally ruling out superfluous teams in the C sector.

Condition 3.1 *The free trade equilibrium replicates the integrated equilibrium if*

$$\forall t \in \left[\underline{t}, \hat{t}\right], \; m^H(t) = m^F(t) = m(t). \tag{3.6}$$

Notice, the aforementioned condition and equation (3.4) imply that $\xi_F(t) = \xi_H(t)$ for all talent levels between $\underline{t}$ and $\hat{t}$. Let us denote by $\widetilde{p}$ the equilibrium price in the integrated equilibrium; as both countries share the same technology, equation (3.6) also implies that $\hat{t} = \hat{t}_H = \hat{t}_F$.

In equilibrium the matching described by $m(\cdot)$ is a function of the distribution of talent in each country, see equation (3.1). The next result relates the previous condition to the talent distributions for each country. It establishes a "similarity" condition that restricts the distributions of talent for each of the countries.

Result 3.1 *Let $m(t)$ be the matching pattern implied by equation (3.1) when applied to the world distribution of talent $\Phi(t)$. Condition 3.1 holds if the distributions of talent Φ_H and Φ_F are such that*

1. *if there exists $t' \in (\underline{t}, \hat{t})$ such that $\Phi_j(t') = 0$, then $\Phi_j(m(t')) = 1$, and*

2. *for all $t \in (\underline{t}, \hat{t})$ such that Φ_H and Φ_F are positive, then*

$$\frac{\Phi_H(t)}{\Phi_F(t)} = \frac{1 - \Phi_H(m(t))}{1 - \Phi_F(m(t))}. \tag{3.7}$$

Proof. Note that the talent distributions are constrained to add up to the total endowment of each talent level in the world economy, i.e., for all t

$$\Phi_H(t) + \Phi_F(t) = 2\Phi(t).$$

Consider first the case when for some $t' > \underline{t}$ we have $\Phi_H(t') > 0$ but $\Phi_j(m(t')) = 1$. This implies that $m_H(t') < m(t')$, thus the integrated equilibrium cannot be replicated.

If equation (3.7) holds we can write

$$\frac{\Phi_H(t)}{\Phi_F(t)} = \frac{1 - \Phi_H(m(t))}{1 - \Phi_F(m(t))} = \alpha(t).$$

Using this condition plus the adding up constraint for the country talent distributions, we obtain that

$$\Phi_F(t) = \frac{2}{1+\alpha(t)}\Phi(t)$$

and

$$1 - \Phi_F(t) = \frac{2}{1+\alpha(t)}(1 - \Phi(t)).$$

By definition, $m_F(t)$ is given by,

$$\Phi_F(t) = 1 - \Phi_F(m_F(t)),$$

which we can rewrite as

$$\frac{N}{1+\alpha(t)}\Phi(t) = 1 - \Phi_F(t) = \frac{2}{1+\alpha(t)}(1 - \Phi(m_F(t))),$$

thus implying that $m_F(t) = m(t)$. ■

As explained before in this section the intuition behind Condition 3.1 is not complicated, it just guarantees that the same matches are feasible, and that given the efficient allocation, they are the equilibrium outcome when countries face the same price. It is useful to consider now the connection between this condition and the statements Result 3.1. The simplest case corresponds to the situation when for some $t' > \underline{t}$ we have $\Phi_H(t') > 0$ but $\Phi_j(m(t')) = 1$. This implies that $m_H(t') < m(t')$, meaning that matches that were observed in the integrated equilibrium, in particular the $(t', m(t'))pair$, are not feasible in the free trade case: agents of talent t' and $m(t')$ are in different countries.

Let us now look at what equation (3.7) implies for the matching patterns in the S sector. Consider the case for some interval $(t_1, t_2) \subset (\underline{t}, \hat{t})$ equation (3.7) does not hold. This can happen if, starting from a pair of distributions for which the condition holds, we reallocate some agents from Home to Foreign and compensate by moving some other agents (still within the same interval) the other way around, thus keeping the size of the countries constant. Assume the integrated equilibrium can be replicated, so the price is given by $\widetilde{p}$; as long as $t_2 \leq \hat{t}$ we have that $m_H(\hat{t}) = m_F(\hat{t}) = m(\hat{t})$, so the cutoff can be the same, which implies that total production of good C is the same. However, for all $t \in (t_1, t_2)$, $m_H(t) \neq m_F(t) \neq m(t)$, hence production of good S would be less than in the integrated equilibrium, and the price cannot be the same as it is not compatible with utility maximization by the agents. The teams associated with the rules $m_H(t)$ and $m_F(t)$ must be less productive in sector S than the ones arising in the integrated equilibrium, a result that follows from the submodularity of the production function.

Assume now that instead of the previous situation we reallocate agents of talents between t_1 and t_2 from home to foreign, and some of talents between t_3 and t_4 larger than $\hat{t}$ but smaller than $m(\hat{t})$ from foreign to home. In this case we have that for all t between t_1 and t_4, including $\hat{t}$, the implied matches, defined by $m_H(\cdot)$ and $m_F(\cdot)$ do not coincide with $m(\cdot)$, and countries facing the same price as the integrated equilibrium will not exhibit the same sorting and matching patterns; this implies that production cannot be the same.

Finally, let us take the last two cases but focus on the case when t_1 and t_2 are between $m(\hat{t})$ and $\bar{t}$. Following the same line of reasoning, we can show that if equation (3.7) does not hold, then the free trade equilibrium cannot replicate the integrated equilibrium: at the same price $\widetilde{p}$ it cannot produce the same amounts of goods C and S.

One common feature in the previous arguments is that when the free-trade equilibrium does not replicate the integrated equilibrium, we can reorganize teams working in sector S obtaining higher production without sacrificing production of good C. In this sense, international teams (or offshoring) initially resemble a productivity improvement in the production in sector S; this "apparent" productivity gain arises because the matches in the free-trade equilibrium are limited by borders, hence forcing inefficient matches and reducing the production of the good.[13] This gain in productivity, that is sector specific in the model because only one sector uses "diverse" matches, then induces a price effect, which changes sorting patterns too.

The change in the sorting pattern, and the resulting change in the composition of teams is just the other side of the coin: borders give a geographical advantage to some agents. Consequently, and although it is not the main point of the chapter, the model also implies that when opening up to international team formation, different agents will experience different effects after the introduction of international teams. At the same time that removing the barrier on international teams generates a better division of labor, it reduces the advantages associated with location. The extent of the effects, both in terms of the efficiency gains and the effects on the factor prices, depends on the differences in the distributions as well as on the "value" of the matches (diversity) in the different sectors.

[13]Other authors have identified similar productivity effects in other models of offshoring and/or fragmentation and trade, see for example Grossman and Rossi-Hansberg (2008), and Rodriguez-Clare (2007).

3.3.2 Some Examples

Constraints on the Support of the Distributions. A clear example of when Condition 3.1 fails is if the support of at least one of the distributions Φ_H and Φ_F does not coincide with the support of $\Phi(t)$, e.g. consider a case when one country receives all the agents above the median talent level and the other takes the rest. In this case, the free trade equilibrium cannot generate teams with agents of talent $\underline{t}$ and $\bar{t}$, which we know give the lowest cost of production of good S. Thus, the integrated equilibrium is not a feasible one under free trade with these distributions.

Corollary 3.2 *For the two-country equilibrium with free trade in goods to replicate the integrated equilibrium, it must be true that for at least one of the countries there exists $\varepsilon > 0$ such that*

$$\Phi_i(\underline{t} + \varepsilon) > 0 \quad \text{and} \quad \Phi_i(\bar{t} - \varepsilon) < 1,$$

i.e., in at least one of the countries the teams $(\underline{t}, \bar{t})$ must be feasible.

This result relates to one of the no-trade results in Grossman and Maggi (2000). There they state that if $\Phi_H(t) = \Phi_F(\beta t)$ for all $(\underline{t}_H, \bar{t}_H)$, then there will be no trade in the free-trade equilibrium. This result comes from the fact that one economy is just a scale of the other and the assumption of constant returns to scale. Notice however, that introducing international teams in this situation can break break the no-trade result: these two countries can start trading goods and there can be international teams in equilibrium. This is always true if $\underline{t}_H > 0$ because in this case either $\underline{t}_H < \underline{t}_F$ and $\bar{t}_H < \bar{t}_F$, or $\underline{t}_H > \underline{t}_F$ and $\bar{t}_H > \bar{t}_F$; any of the two cases imply that the first part of Result 3.1 does not hold, hence the free trade equilibrium does not replicate the integrated economy.

Symmetric Distributions. When the world distribution of talent is symmetric, Lemma implies that the country distributions have to be symmetric around t_m on the tails, with tails defined as $(\underline{t}, \hat{t})$ and $(t_m, \bar{t})$. To see this, suppose that the distributions are not symmetric around t_m, but instead we assign all agents with talent $t < t_m$ to the home country and the rest to the foreign country. In this case we have that the first part of Result 3.1 does not hold, thus the inability to replicate the integrated equilibrium.

Corollary 3.3 *The condition in Lemma 3.1 implies that if $\Phi(t)$ is symmetric, then Φ_H and Φ_F must be symmetric around t_m for all $\underline{t} \leq t \leq \hat{t}$ and $\hat{t} \leq t \leq \underline{t}$ for the equilibrium with free trade in goods to replicate the integrated equilibrium.*

3.4 Concluding Remarks

Offshoring and multinational firms are an important part of international trade. In this chapter I extend a model of trade with heterogeneous agents and production teams to study the role of international team formation in a context with free trade in goods.

It is shown that in the two-country case when the tails of the countries' talent distributions satisfy a "similarity" condition, then free trade in goods replicates the integrated equilibrium. However, this condition is strong and it implies that generally international teams will change the allocation of agents, even in the presence of free trade in goods, thus enlarging the production set of the world economy when combined with free trade in goods. When international teams are allowed, i.e., pairings that comprise workers in different countries, the two-country equilibrium replicates the integrated equilibrium. This implies that international teams generate efficiency gains as they expand the production possibility set and, in this case, they do so in a way such that the economy reaches the most efficient allocation. The basic mechanism for this result lies in the fact that international teams allow the creation of production teams that are not feasible when borders limit the pairing of agents: the reallocation of agents across teams and across sectors is the microeconomic basis for the aggregate effects.

This chapter then shows one plausible channel through which offshoring and trade in services can benefit countries. The effect arises from an endogenous pattern of sorting among heterogenous agents; it is also shown that the effect does not disappear when trade in good is already in place: free trade in goods alone need not replicate the integrated equilibrium, while international teams coupled with free trade in goods does replicate it.

Appendix A

Appendix to Chapter 1

A.1 Proofs and Extensions to the Model

A.1.1 Omitted Proofs from Section 1.3

Proof of Lemma 1.1. The entrepreneur problem is

$$\max_k \; w_0 - c(k) + ak + \mu[w_0 - c(k)],$$

where μ is the Lagrange multiplier for the resource constraint $w_0 - c(k) \geq 0$. With unrestricted access to financial markets this constraint is not relevant and the first order condition of the problem implies

$$c'(k) = a,$$

which leads to equation (1.1).[1] The case with a borrowing constraint is simple, if the first best is achievable, i.e. if $w_0 \geq c\left(k^{FB}\right)$, then $k = k^{FB}$ is the solution; if $w_0 < c\left(k^{FB}\right)$, the entrepreneur will invest the maximum she can. The liquidity shock plays no role because ex-post the entrepreneur can always borrow resources to meet the needs and then return it (as it is not a real cost). ∎

Writing the Entrepreneur's Problem in Equation 1.6. In period 1 the entrepreneur maximizes expected resources in period 3 by choosing the number of production units to build.

[1]The assumptions about $c(\cdot)$ imply the inverse exists.

The expected resources in period 3 is obtained computing the expected value of

$$R(\theta) = \begin{cases} w_0 - c(k) + ak & \text{if } \theta < \theta^* \\ w_0 - c(k) + (a+\eta)\frac{w_1}{\theta} - \eta k & \text{if } \theta \geq \theta^* \end{cases},$$

using the assumption that the lower bound of the distribution is 0:

$$\begin{aligned} R(k|w_0) &= \int_0^{\theta^*} [s_0 + ak] f(\theta) d\theta \\ &+ \int_{\theta^*}^{\infty} [s_0 + a \underbrace{\frac{w_1}{\theta}}_{=\lambda} - \eta(k - \underbrace{\frac{w_1}{\theta}}_{=\lambda})] f(\theta) d\theta \\ &= s_0 + \int_0^{\theta^*} akf(\theta) d\theta + \int_{\theta^*}^{\infty} [(a+\eta)\lambda - \eta k] f(\theta) d\theta \\ &= s_0 + \int_0^{\theta^*} [(a+\eta)k - \eta k] f(\theta) d\theta + \int_{\theta^*}^{\infty} [(a+\eta)\lambda - \eta k] f(\theta) d\theta \\ R(k|w_0) &= s_0 + \int_0^{\infty} [(a+\eta)\lambda - \eta k] f(\theta) d\theta, \end{aligned}$$

where in the last step we use the fact that $\lambda = k$ for $\theta < \theta^*$. ■

Proof for Proposition 1.1. First notice that the problem must admit a solution because the objective function is concave and we are maximizing over a compact set (a closed interval on the real line).

The first order condition is

$$\frac{\partial R}{\partial k} = -c'(k) + \int_0^{\theta^*} af(\theta) d\theta - \int_{\theta^*}^{\infty} \left[(a+\eta)\frac{c'(k)}{\theta} + \eta\right] f(\theta) d\theta = 0, \tag{A.1}$$

where θ^* is defined in equation (1.4).[2]

Let us start with the case when $w_0 < w^{FB}$.

Evaluate equation (A.1) at $k = 0$, there we obtain

$$\left.\frac{\partial R}{\partial k}\right|_{k=0} = \int_0^{\infty} af(\theta) d\theta = a > 0,$$

[2]The second order condition confirms that at an interior point, the solution to this equation is indeed a maxima. The proof deals with the cases where one of the corners is a solution.

and that established that $k^*(\cdot) > 0$. On the other hand, at $k = \overline{k}$ we obtain

$$\left.\frac{\partial R}{\partial k}\right|_{k=\overline{k}} = -c'\left(\overline{k}\right) + \int_0^{m/\overline{k}} af(\theta)\,d\theta - \int_{m/\overline{k}}^{\infty} \left[(a+\eta)\frac{c'\left(\overline{k}\right)}{\theta} + \eta\right] f(\theta)\,d\theta,$$

which can be positive or negative. Notice though that for $m = 0$, this expression must be negative; however, as $m \to \infty$, then the expression becomes positive. We can also show that it is monotonically increasing in m, hence there exists a value of m such that this expression is 0, denote this value by $\widehat{m}(w_0, a)$. This implies that if $m > \widehat{m}(\cdot)$, then the solution is such that the entrepreneur invests all her available resources in stage 0, and uses m to cope with the liquidity shock.[3] Intuitively, in this case the shadow value of keeping aside one dollar in stage 0, i.e. creating fewer units, is too high compared to the benefit in terms of saving extra units in stage 1.

Consider now the case when $m < \widehat{m}(\cdot)$, using the fact that θ^* is strictly decreasing on k and continuous on $[0, \overline{k}]$, and the assumption that $f(\theta)$ is strictly positive, we obtain that the right hand side of equation (A.1) is continuous and decreasing on k, for $k \in \left[0, \overline{k}\right]$. Then, if $m < \widehat{m}(\cdot)$ there is a *unique interior* solution to equation (A.1) in the interval $\left(0, \overline{k}\right)$. As mentioned before, the second order conditions confirm that the solution to equation (A.1) is indeed a maxima.[4] This solution implies also that $k^* < k^{BC}$, for $w < w^{FB}$ and $m < \widehat{m}(\cdot)$.

Finally, let us consider the cases when $w_0 > w^{FB}$, so $k^{BC} = k^{FB}$. Notice in this case, for any $m < \infty$, if $k = k^{FB}$ there always is a positive probability of losing at least some units (and maybe all of them). We can see that k^{FB} cannot be a solution if we evaluate the first order condition,

$$\begin{aligned}
\left.\frac{\partial R}{\partial k}\right|_{k=k_{FB}} &= -\underbrace{c'\left(k^{FB}\right)}_{=a} + \int_0^{\theta_{FB}} af(\theta)\,d\theta - \int_{\theta^{FB}}^{\infty} \left[(a+\eta)\frac{c'\left(k^{FB}\right)}{\theta} + \eta\right] f(\theta)\,d\theta \\
&= -a\left(1 - F\left(\theta^{FB}\right)\right) - \int_{\theta^{FB}}^{\infty} \left[(a+\eta)\frac{a}{\theta} + \eta\right] f(\theta)\,d\theta < 0,
\end{aligned}$$

where $\theta^{FB} \equiv \theta^*\left(w_0, m, k^{FB}\right)$. Thus, the entrepreneur will always choose $k^* < k^{FB}$ even if she can pay the creation cost $c\left(k^{FB}\right)$.

The intuition behind this result is not complicated, around the first best a marginal reduction in creation has two benefits: first, at the margin, the expected return of the last unit is negative because the expected return, $aF\left(\theta^{FB}\right)$, is lower than the cost of creating that unit, $c'\left(k^{FB}\right) = a$.

[3] Intuitively, in this case the shadow value of keeping aside one dollar in stage 0 is too high compared to the benefit in terms of saving extra units.

[4] If we had allowed for $F(\cdot)$ to have an atom at 0, then it would also be possible to have a solution with $k = \overline{k}$ for low enough levels of w_0.

Second, it also leads to a reduction in the expected costs coming from destruction as more units can be saved with the extra resources freed in stage 0. Consequently, even if the entrepreneur can afford to invest the first best, it will never be the optimum in our setup to invest up to that level. This implies that $k^* < k^{BC} = k^{FB}$, for $w \geq w^{FB}$. ■

Proof of Proposition 1.2. To establish that optimal investment is increasing in w_0, we differentiate both sides of equation (A.1) with respect to w_0 and rearrange terms to obtain

$$\begin{aligned}\frac{dk^*}{dw_0} &= \frac{1}{k^*}\frac{f\left(\widehat{\theta}\right)(a+\eta)\left(1+\frac{c'(k^*)}{\widehat{\theta}}\right)}{c''(k^*)\left[1+\int_{\widehat{\theta}}^{\infty}\frac{a+\eta}{\theta}f(\theta)\,d\theta\right]-f\left(\widehat{\theta}\right)(a+\eta)\left(1+\frac{c'(k^*)}{\widehat{\theta}}\right)\frac{d\theta^*}{dk}\big|_{k^*}} \\ &= \frac{\Pi}{c'(k^*)+\widehat{\theta}} > 0,\end{aligned}$$

where

$$\Pi = \left[1-\frac{c''(k^*)\left[1+\int_{\widehat{\theta}}^{\infty}\frac{a+\eta}{\theta}f(\theta)\,d\theta\right]}{f\left(\widehat{\theta}\right)(a+\eta)\left(1+\frac{c'(k^*)}{\widehat{\theta}}\right)\frac{d\theta^*}{dk}\big|_{k^*}}\right]^{-1} < 1,$$

and $\widehat{\theta}$ is given by equation (1.9). The sign of Π follows from our assumptions about $c(\cdot)$ and the fact that $\frac{d\theta^*}{dk} = -\frac{c'(k)+\theta^*}{k} < 0$. If the solution is in the region where $k^* = c^{-1}(w_0)$, then it is clear that creation is also increasing on w_0. A similar argument is true for the case of changes in m, except when in the region where $k^* = c^{-1}(w_0)$, in which case creation is independent of m.

The effect of η on creation, k^*, is established differentiating both sides of equation (A.1) with respect to η to obtain

$$\frac{dk^*}{d\eta} = -\frac{1-F\left(\widehat{\theta}\right)}{\Phi} < 0,$$

where

$$\Phi = c''(k^*)\left[1+\int_{\widehat{\theta}}^{\infty}\frac{a+\eta}{\theta}f(\theta)\,d\theta\right]+1+\int_{\widehat{\theta}}^{\infty}\frac{c'(k^*)}{\theta}f(\theta)\,d\theta - f\left(\widehat{\theta}\right)(a+\eta)\left(1+\frac{c'(k^*)}{\widehat{\theta}}\right)\frac{d\theta^*}{dk}\bigg|_{k^*} > 0.$$

To derive the effect of w_0 on destruction, differentiate equation (1.8) with respect to w_0,

$$\frac{d\widehat{D}}{dw_0} = \left(1-F\left(\widehat{\theta}\right)\right)\frac{dk^*}{dw_0} - \left(1-c'(k^*)\frac{dk^*}{dw}\right)\int_{\widehat{\theta}}^{\infty}\frac{1}{\theta}f(\theta)\,d\theta.$$

This expression cannot be signed. A similar result arises if we consider the derivative with respect to m for $m < \widehat{m}$. If we are in the case where k^* is pinned down by w_0, then a fall in m leads to an increase in destruction while a fall in w_0 leads to a fall in destruction.

Finally, the effect of η on destruction is simpler to obtain. First notice that under the assumption of the shock being a pure liquidity shock the firm always wants to save as many units as possible, irrespective of the destruction cost. Hence, any effect of η on destruction must come from the creation side, k^*, and we know that $\frac{dk^*}{d\eta} \leq 0$, implying then that destruction in non-increasing on η. If the investment decision has already been taken, the effect then disappears. ■

Proof of Lemma 1.2. It follows from differentiating equation (1.7) with respect to m holding $k = k^*$:

$$\frac{dD}{dm} = -\int_{\hat{\theta}}^{\infty} \frac{1}{\theta} f(\theta)\, d\theta < 0.$$

■

A.1.2 The Entrepreneur's Problem with Short-run Revenue

Consider the same model outlined in section 1.3, but assume now that the entrepreneur obtains some revenue from each production unit in stage 1, before the liquidity shock is realized. In particular, a production units is now characterized by a vector (a_1, a_2), where a_1 is the flow generated in stage 1, or short-run revenue, and a_2 is the revenue generated in stage 2. We can think of a_1 as revenue coming from sales paid for in cash, and a_2 as revenue coming from sales paid for using other method of payment that do not immediately generate liquid resources for the entrepreneur.

In this case the entrepreneur problem's at stage 0 is

$$\max_{0 \leq k \leq \bar{k}} \; w_0 - c(k) + a_1 k + \int \left[(a_2 + \eta)\, \lambda(\theta, k) - \eta k \right] f(\theta)\, d\theta,$$

subject to

$$\lambda(\theta, k) \equiv \min \left\{ k, \frac{w_0 - c(k) + a_1 k}{\theta} \right\},$$

and

$$\theta^*(w_0, k) \equiv \frac{w_0 - c(k) + a_1 k}{k}.$$

Now total productivity of the unit equals $(a_1 + a_2)$. In particular, for a given value of (a_1, a_2), there exists a level of w_0 such that the optimal investment uses up all the resources in stage 0, and the firm uses the short-run revenue to cope with the liquidity shock. Outside this region, the solution is qualitatively the same as in the case with all the revenue coming in stage 2. The first best is never achieved, and total investment is increasing in w_0.

Notice also that a higher value of a_1 has two effects. First, it increases total investment by increasing total productivity, an effect that is present in the first best and the second best with a financial constraint in stage 0 only. Second, it alleviates the liquidity constraint in stage 1, hence there is an extra effect on investment because of the shadow value of liquid resources in stage 1.

In the empirical section, our proxy variables for liquidity needs can also be interpreted as mapping sector specific variations in the composition of a_1 and a_2.

A.2 Appendix Tables

Table A.1. Description of the main variables used in the paper.

Variable	Source	Description
Destruction	from Haltiwanger et al. (2004)	Job destruction by firms in a given sector, country and year; see (1.13).
Creation	from Haltiwanger et al. (2004)	Job creation by firms in a given sector, country and year; see equation (1.12).
SS	own construction, based on Gallego and Jones (2005)	Fraction of the year that the country is in a sudden stop.
Fin1	own construction based on RZ data	Mean across subsectors of the original Rajan-Zingales measure of financial dependence.
Fin2	own construction based on Micco and Pagés (2006) data	Mean across subsectors of the Micco and Pagés (2006) computation of the Rajan-Zingales measure of financial dependence.
Fin3	from Raddatz (2006)	Computation of the original RZ measure of (long-run) external finance dependence. Unlike our previous two measures, this corresponds to the median firm for the 2-digit sector, and not to the mean of the median firm of each subsector.
I/S	from Raddatz (2006)	Median ratio of inventories to sales in 1980-1989 in the US, using Compustat data.
CCC	from Raddatz (2006)	Median across firms of the cash conversion cycle variable. It estimates the length in days between a firm pays for its raw materials and it receives the payment for the final sales. We express this variable in hundreds of days.
Labor	own construction using data from Botero et al. (2004)	We consider the sum of *firing* and *dismiss.*
LR	from Micco and Pagés (2006)	It measures labor reallocation in US industries as the sum of job creation and job destruction as fraction of total employment.
firing	from Botero et al. (2004)	It measures how expensive it is for a firm to fire 20% of the workers; it includes all the compensations and penalties needed to pay in this case.
dismiss	from Botero et al. (2004)	It counts the number of measures a firm must undertake in order to be able to dismiss a worker; the variable used is the ratio of procedures required as a fraction of the total number of procedures considered (seven).
RER	from IFS and local central banks	Effective real exchange rate, year average, 1995=1.

Note: The series *Inv/Sales*, *CCC* and *Fin3* were generously provided by Claudio Raddatz.

Table A.2. Descriptive Statistics: Job Creation and Destruction. Main countries plus Argentina and Uruguay.

			Argentina			
Variable	Type	Obs	Mean	Std. Dev.	Min	Max
Creation	Cont	99	0.053	0.023	0.014	0.136
Creation	All	.	.	.	.	.
Destruction	Cont	99	0.089	0.032	0.023	0.208
Destruction	All	.	.	.	.	.
			Uruguay			
Variable	Type	Obs	Mean	Std. Dev.	Min	Max
Creation	Cont	63	0.050	0.026	0.006	0.150
Creation	All	.	.	.	.	.
Destruction	Cont	63	0.088	0.043	0.033	0.234
Destruction	All	.	.	.	.	.

Table A.3. Dataset Characteristics by Country

Country	Argentina	Brazil	Chile	Colombia	Mexico	Uruguay
Type data	Job	Job + Workers	Job	Job	Job + Workers	Job
Source	INDEC	RAI	ENIA	EAM DANE	IMSS	INE
Period	91-01	92-00	80-99	77-91 and 93-99	94-00	89-95
Coverage	Manuf	Private (Formal)	Manuf	Manuf	Private	Manuf
Unit	Firms	Plants	Plants	Plants	Firms	Plants

Table A.4. Job Creation, continuing plants and all countries. Same as Panel (b), Table 1.3 but including observations for Argentina and Uruguay. All explanatory variables, except SS, are expressed as deviation with respect to their sample means. Country, time and sector fixed effects are included, we also control for Rule of law.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
SS	-0.006	-0.006	-0.006	-0.003	-0.006	-0.006	-0.006
	[0.004]	[0.004]*	[0.004]*	[0.004]	[0.004]*	[0.004]	[0.004]*
Labor*SS	-0.051	-0.052	-0.051	-0.052	-0.052	-0.051	-0.051
	[0.013]***	[0.013]***	[0.013]***	[0.013]***	[0.013]***	[0.013]***	[0.013]***
Fin1*SS		-0.045					-0.055
		[0.019]**					[0.028]**
CCC*SS			-0.009				0.007
			[0.008]				[0.012]
Fin3*SS				-0.028			
				[0.010]***			
Fin2*SS					-0.028		
					[0.010]***		
(I/S)*SS						-0.021	
						[0.064]	
N. Obs	646	646	646	646	646	646	646
R-squared	0.55	0.55	0.55	0.55	0.55	0.55	0.55

Robust standard errors in brackets.
* significant at 10%, ** significant at 5%, *** significant at 1%

Table A.5. Job Destruction, continuing plants and all countries. Same as Panel (b) in Table 1.4 but including observations for Argentina and Uruguay. All explanatory variables, except SS, are expressed as deviation with respect to their sample means. Country, time and sector fixed effects are included, we also control for Rule of law.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
SS	0.035	0.035	0.035	0.031	0.035	0.035	0.035
	[0.006]***	[0.006]***	[0.006]***	[0.006]***	[0.006]***	[0.006]***	[0.006]***
Labor*SS	0.05	0.051	0.052	0.051	0.051	0.051	0.052
	[0.018]***	[0.018]***	[0.018]***	[0.018]***	[0.018]***	[0.018]***	[0.018]***
Fin1*SS		0.054					-0.01
		[0.034]					[0.046]
CCC*SS			0.039				0.042
			[0.012]***				[0.017]**
Fin3*SS				0.038			
				[0.018]**			
Fin2*SS					0.027		
					[0.018]		
(I/S)*SS						0.255	
						[0.091]***	
N. Obs	646	646	646	646	646	646	646
R-squared	0.5	0.5	0.5	0.5	0.5	0.5	0.5

Robust standard errors in brackets.
* significant at 10%, ** significant at 5%, *** significant at 1%

Appendix B

Appendix to Chapter 2

B.1 Derivations and Proofs

Proof of Lemma 2.1. Write the lagrangean for the agent's problem as

$$\max_{h,l,\eta} u\left(\frac{w}{p}l + f(h)\right) + v(1 - h - l) + \eta l, \tag{B.1}$$

then the results follow from the Kuhn-Tucker conditions of the problem. ■

Proof of Lemma 2.2. Write the first order conditions of equation (B.1) as

$$\begin{aligned} f'(\cdot)\,u'(\cdot) - v'(\cdot) &= 0 \\ \frac{w}{p}u'(\cdot) - v'(\cdot) &= 0, \end{aligned}$$

for the case when η is zero. With little algebra we obtain

$$f'(h) = \frac{w}{p}.$$

The comparative statics for h and l are then obtained differentiating these last equation and one of the first order conditions with respect to p. The result for x_m comes from the fact that with $I = 0$, $x_m = (wl)/p$.

The statement about the solution when labor supply is 0, follows from the characterization of the solution in Lemma 2.1. ■

B.2 Additional Tables

Table B.1. IV Estimations of the Effect of LS immigration on US prices from Cortés (2006).

Explanatory Variable	**Dependent Variable is** ln(*Price Index*)			
	Ind. highly intensive in the use of LS Immigrants		All Goods and Services	
	Non-Traded	Traded	Non-Traded	Traded
ln($AggLS/HSLabor$)	-0.420	0.051	-0.146	-0.059
	(0.169)	(0.142)	(0.095)	(0.051)
Region*Decade FE	Yes	Yes	Yes	Yes
No. of Observations	300	750	1650	1850
No. of Industries	6	15	33	37

Notes: All regressions include city, decade, and industry*decade fixed effects. Standard Errors clustered at the city*decade level are reported in parenthesis. Services included in the non-traded highly intensive in LS Immigrants are: Baby-sitting, housekeeping, gardening, dry cleaning, shoe repair and barber shops.

Table B.2. Occupations of Women with a Professional Degree or PhD (1990).

All	%	Prof. Degree	%	Ph.D.	%
Lawyers	20.7	Lawyers	27.1	Professors	22.2
Reg. Nurses	11.4	Reg. Nurses	14.9	Psychologists	12.2
Physicians	9.5	Physicians	12.0	Managers in Education	7.6
Professors	6.4	NA	4.9	Primary school teacher	5.3
NA	4.3	Lic. Nurses	2.2	Managers, n.e.c	4.7
Psychologists	3.6	Primary school teacher	2.0	Lawyers	2.7
Primary school teacher	2.9	Managers, n.e.c	1.9	Technicians	2.7
Managers, n.e.c.	2.6	Dentists	1.8	NA	2.6
Managers in Education	2.4	Pharmacists	1.7	Physicians	2.4
Lic. Nurses	1.6	Cosmetologists	1.4	Teachers, n.e.c	2.2
Pharmacists	1.4	Nursing aids	1.4	Reg. Nurses	1.6
Dentists	1.4	Veterinarians	1.3	Biological Scientists	1.4
Nursing aides	1.1	Secretaries	1.2	Medical Scientists	1.2

Source: Census 1990.

Appendix C

Appendix to Chapter 3

C.1 Proofs of Claims in the Note

C.1.1 Proof of Equation (3.5)

Notice that

$$\xi(\hat{t}) \propto \varpi \equiv \frac{F^S\left(\hat{t}, m(\hat{t})\right)}{\lambda\left(\hat{t} + m(\hat{t})\right)}.$$

We want to show that $d\varpi/d\hat{t} < 0$. Differentiating with respect to $\hat{t}$ we obtain

$$\frac{d\varpi}{d\hat{t}} = \frac{1}{\lambda\left(\hat{t} + m(\hat{t})\right)} \left[\left(F_1^S + F_2^S \frac{dm(\hat{t})}{d\hat{t}} \right) \left(\hat{t} + m(\hat{t})\right) - F^S \left(1 + \frac{dm(\hat{t})}{d\hat{t}} \right) \right],$$

and as the denominator is positive we can focus on the numerator in order to sign the fraction. For this, rearrange terms to obtain

$$\begin{aligned} &\left[F_1^S\left(\hat{t}, m(\hat{t})\right)\left(\hat{t} + m(\hat{t})\right) - F^S\left(\hat{t}, m(\hat{t})\right)\right] \\ &\qquad - \left(\frac{\phi(\hat{t})}{\phi\left(m(\hat{t})\right)}\right)\left[F_2^S\left(\hat{t}, m(\hat{t})\right)\left(\hat{t} + m(\hat{t})\right) - F^S\left(\hat{t}, m(\hat{t})\right)\right] \end{aligned}$$

Let me consider the two terms in the previous expression separately. The first expression can be written as

$$\begin{aligned}
&F_1^S\left(\hat{t}, m(\hat{t})\right)\left(\hat{t}+m(\hat{t})\right) - F^S\left(\hat{t}, m(\hat{t})\right) = \\
&\qquad =F_1^S\left(\hat{t}, m(\hat{t})\right)\hat{t} + F_2^S\left(\hat{t}, m(\hat{t})\right)m(\hat{t}) - F^S\left(\hat{t}, m(\hat{t})\right) \\
&\qquad + \left[F_1^S\left(\hat{t}, m(\hat{t})\right) - F_2^S\left(\hat{t}, m(\hat{t})\right)\right],
\end{aligned}$$

where the first three terms on the right hand side equal 0 because of the CRS assumption. The second term can be signed using the fact the production function is symmetric. For this notice that

$$F_2^S\left(\hat{t}, m(\hat{t})\right) = F_1^S\left(m(\hat{t}), \hat{t}\right),$$

thus,

$$\begin{aligned}
&F_1^S\left(\hat{t}, m(\hat{t})\right) - F_2^S\left(\hat{t}, m(\hat{t})\right) = \\
&\qquad = \left[F_1^S\left(\hat{t}, m(\hat{t})\right) - F_1^S\left(m(\hat{t}), \hat{t}\right)\right] < 0,
\end{aligned}$$

because $F_{11}^S > 0$, $F_{12}^S < 0$, and $m(\hat{t}) > \hat{t}$.

Similarly we can show that the second term

$$\left[F_2^S\left(\hat{t}, m(\hat{t})\right)\left(\hat{t}+m(\hat{t})\right) - F^S\left(\hat{t}, m(\hat{t})\right)\right],$$

is negative, and by definition

$$\frac{\phi(\hat{t})}{\phi\left(m(\hat{t})\right)} > 0.$$

All this together implies that $\xi(\hat{t})$ in decreasing in $\hat{t}$. This result then determines the shape of the production possibility frontier when matching and sorting happen according to the results in Lemma 3.1 and 3.2.

C.2 An Example with a Discrete Distribution of Talent

It is important to emphasize the main qualitative results regarding the relation between trade in goods and international team formation do not hinge on the assumptions about the distribution. In this appendix I provide an example of a discrete distribution, and we can see, both mathematically and graphically, that international team formation weakly increases the production frontier of the two-country world.

Set-up and Integrated Equilibrium. Assume that the distribution of talent in the world is discrete: two levels of t: $t_1 = 1, t_2 = 2$, with a measure 1 of each. Also assume that preferences are

$$U(C, S) = \ln C + \ln S.$$

Production in both sectors is given by

$$F^C(t_A, t_B) = \begin{cases} 2 & \text{if}\,(1,1) \\ 2.5 & \text{if}\,(1,2) \text{ or } (2,1) \\ 4 & \text{if}\,(2,2) \end{cases}$$

$$F^S(t_A, t_B) = \begin{cases} 2 & \text{if}\,(1,1) \\ 3.5 & \text{if}\,(1,2) \text{ or } (2,1) \\ 4 & \text{if}\,(2,2) \end{cases}$$

In integrated allocation comsumption is given by $C = 3/2$, and $S = 7/4$. There are 0.5 cross matches producing good S.

Trade in Goods. Now suppose we split the world into two countries (as in Samuelson's angels story), and that these two countries' endowments are

- Home (H) gets 0.2 of t_1 and 0.8 of t_2
- Foreign (F) gets 0.8 of t_1 and 0.2 of t_2

In this case the integrated allocation cannot be achieved (see Figure C-1). Using the first order conditions we can also find the wages for workers of each talent level. For this, note that the

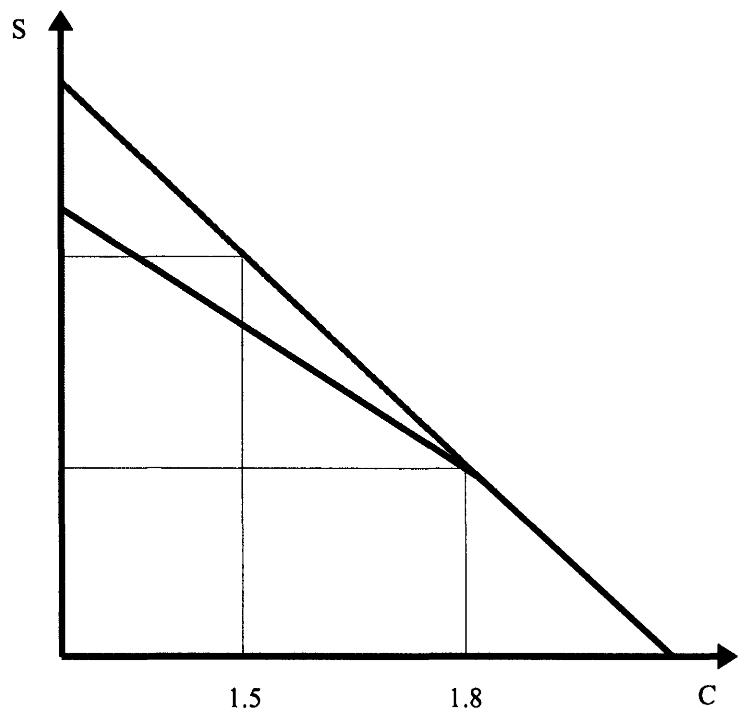

Figure C-1. The World's Production Possibility Frontier with and without International Teams in the Case of a Discrete Talent Distribution. The black line corresponds to the world possibility frontier when there is free trade in good but no international teams. The blue line corresponds to the extra production points available when there are international teams and trade in goods, it also corresponds to the integrated equilibrium.

marginal match producing S is a self match, hence the relative price is now 1 (Figure C-1). Using the matches in the C sector we obtain that $w_F(t_1) = 1$, $w_F(t_2) = 2.5$, $w_H(t_1) = 1.5$, and $w_H(t_2) = 2$. Showing that additionally there is no FPE even with free trade in goods if the integrated allocation cannot be replicated without cross-border matches.

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