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ABSTRACT

Growth and Risk at the Industry Level: the Real Effects of Financial Liberalization*

This paper analyzes the effects of financial liberalization on growth and volatility at the industry level in a large sample of countries. We estimate the impact of liberalization on production, employment, firm entry, capital accumulation, and productivity, using both de facto and de jure measures of liberalization. In order to overcome omitted variables concerns, we employ a number of alternative difference-in-differences estimation strategies. We implement a propensity score matching algorithm to find a control group for each liberalizing country. In addition, we exploit variation in industry characteristics to obtain an alternative set of difference-in-differences estimates. Financial liberalization is found to have a positive effect on both growth and volatility of production across industries. The positive growth effect comes from increased entry of firms, higher capital accumulation, and an expansion in total employment. By contrast, we do not detect any effect of financial liberalization on measured productivity. Finally, the growth effects of liberalization appear temporary rather than permanent.

JEL Classification: F02, F21, F36 and F4
Keywords: difference-in-differences estimation, financial liberalization, growth, industry-level data, propensity score matching and volatility

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1 Introduction

Financial markets have been liberalized dramatically in many countries over the past three decades. Figure 1 depicts recent trends in the indicators of financial openness. Most de jure measures of restrictions on domestic capital allocation or international capital flows show a strong trend towards liberalization. Indeed, capital flows across borders have correspondingly grown at a higher pace than the expansion of goods trade, and much faster than GDP. What are the effects of financial liberalization? In spite of a theoretical case that financial liberalization should improve the allocation of capital and increase growth, the growth effects of financial liberalization have not been easy to demonstrate in cross-country data. At the same time, worries persist that financial liberalization may result in higher volatility.[1]

This paper examines the relationship between financial liberalization, growth, and volatility using a large industry-level panel dataset. The empirical analysis answers three sets of questions. First, what is the impact of financial liberalization on output growth and volatility at the industry level? Both growth and volatility effects have been analyzed separately in cross-country data. However, to obtain a reliable estimate of the their relative importance it is essential to consider these effects within a unified empirical framework. Second, what are the channels through which financial liberalization affects growth? And third, are the effects of financial liberalization permanent or temporary? The answers to the last two questions shed light on the nature of the relationship between liberalization and growth, and can help distinguish between the different theoretical possibilities.

The main findings can be summarized as follows. Financial liberalization increases both growth and volatility of output. These effects are robust to a variety of specifications and estimation strategies. The growth effect is driven by higher employment, greater capital accumulation, and greater firm entry. By contrast, we do not detect any impact of liberalization on TFP growth. Finally, the growth impact is temporary rather than permanent: for output, firm entry, and employment, the effect decreases in magnitude over time, and becomes insignificant after 6 years, while the impact on capital accumulation is slightly more long-lasting. The only persistent effect is on competition: the impact of financial liberalization on the price-cost margin – a measure of markups – increases progressively for the first few post-liberalization years, and remains significantly negative throughout the period we analyze. We conclude that financial liberalization has a permanent effect on the *level* of

[1] Kose, Prasad, Rogoff, and Wei (2006) provide a comprehensive exposition of basic facts about the current wave of financial globalization, and review existing literature on its growth and volatility effects.

output, but no persistent effect on output *growth*. While the impact of financial liberalization on volatility is also most pronounced on impact, we cannot rule out the possibility of a permanent increase in variance of output growth.

What are the implications of there findings for welfare? An increase in both growth and volatility following liberalization has opposite effects. The final section of the paper uses the rich set of empirical results to perform a simple welfare analysis of the impact of financial liberalization in the spirit of Lucas (1987). We find that the consumption gains associated with a permanent increase in the level of output outweigh the welfare costs associated with a higher volatility of output growth. The net welfare gains are nevertheless significantly reduced when, following Reis (2007), we account for the persistence of output shocks.

When it comes to interpreting these results, it is useful to consider the range of theoretical explanations of the growth benefits associated with financial liberalization. At one extreme, in a standard deterministic neoclassical framework, capital mobility accelerates convergence but has no long-run effect on growth or the level of income.[2] At the other extreme, in an endogenous growth framework risk-diversification and specialization in more efficient technologies can have permanent growth-enhancing effects.[3] Our findings of a permanent level effect but no persistent growth effect seem to reject either of these two polar views. However, they are consistent with the notion that capital mobility raises production efficiency by reducing domestic distortions.[4] In particular, our empirical results can be rationalized within a neoclassical model with imperfect competition. In such a model, a permanent reduction in markups leads to a temporary growth increase reflecting convergence towards higher levels of capital and income.[5]

Until recently, most of the empirical literature studying financial liberalization used country-level data, and as a result was subject to both conceptual and econometric problems. First, conceptually, if financial markets are not perfect within the country, the economy does not behave like a representative agent. Indeed, there is strong evidence that risk sharing between agents within a country is far from complete even in the most advanced economies like the U.S. (Attanasio and Davis, 1996, Hayashi, Antonji, and Kotlikoff, 1996). For

[2] See Barro, Mankiw, and Sala-i-Martin (1995), and Gourinchas and Jeanne (2006).

[3] See Saint-Paul (1992) and Obstfeld (1994).

[4] See Tornell and Velasco (1992) and Quadrini (2005) for models in which capital mobility reduces production inefficiencies associated with imperfect property rights or time-inconsistent fiscal policies. In contrast, Tressel and Verdier (2006) suggest that financial liberalization can increase production inefficiencies by exacerbating the misallocation of credit towards politically connected firms.

[5] See Galí (1994, 1995) for a detailed analysis. Note that in this model, output growth volatility tends to increase temporarily as an economy transitions from a steady-state with a low level of capital and high markups to a steady-state with high level of capital and low markups.

developing countries as well, there is a large amount of evidence, surveyed in Banerjee and Duflo (2005), that the representative agent assumption is strongly violated. When that is the case, analyzing aggregate data may in some cases lead us to miss the most important effects of financial liberalization, and in others produce estimates that are not informative about welfare implications for the average individual in the economy (Levchenko, 2005, Broner and Ventura, 2006). The use of sector-level data therefore enables us to get a deeper understanding of how financial liberalization affects the typical agent. In the last section of the paper, we demonstrate the importance of the distinction between industry-level and aggregate effects.

Second, existing cross-country results are most likely subject to significant endogeneity and omitted variables problems. The key feature of our empirical approach is the variety of empirical strategies we employ in order to obtain reliable estimates. To assess robustness of the results, we use both de facto and de jure measures of financial liberalization.[6] In the first exercise, we estimate the relationship between de facto measures of financial liberalization, such as those used by Kose, Prasad, and Terrones (2003) and Lane and Milesi-Ferretti (2006) and growth and volatility. The second exercise is based on de jure measures. We isolate a number of financial liberalization episodes using the liberalization indices developed by Kaminsky and Schmukler (2007) and compare the growth and volatility of outcomes, such as output and employment, during the 10 years immediately before and after the liberalization date. This approach is much more demanding on the data than the simple panel estimation. For instance, a great deal depends on the precise dating of liberalization episodes. Nonetheless, and in spite of the important differences in the independent variables and approaches, the findings are remarkably similar across the two empirical models.

To address the omitted variables problem, the paper uses two difference-in-differences strategies. The first, more conventional one, exploits differences in sector characteristics in the spirit of Rajan and Zingales (1998) to identify a causal link between liberalization and growth and volatility. The second approach, more novel to this paper, uses as the control group countries that did not liberalize in the same period. To overcome a selection on observables problem that could arise in such an exercise, we develop a propensity score matching procedure to select a suitable control group for each liberalizing country.

This paper is related to the large literature on the growth and volatility effects of finan-

[6] The advantage of de jure measures is that they reflect policy levers, and thus results based on them may have clearer policy implications for reforms that a government might consider. Their disadvantage is that they may capture quite poorly the actual degree of financial integration, either because the true nature of legal restrictions is mismeasured, or because these restrictions are imperfectly enforced. De facto indicators of integration do not suffer from this shortcoming.

cial liberalization, surveyed comprehensively by Kose, Prasad, Rogoff, and Wei (2006) and Henry (2006). Here, we focus on the papers most closely related to ours. While most existing studies in this literature use cross-country data, Galindo, Micco, and Ordoñez (2002), and Gupta and Yuan (2006) employ industry-level data and the Rajan and Zingales (1998) methodology to analyze the effects of financial liberalization on growth. Our paper differs from these two contributions in several important respects. First, we investigate the volatility effects of financial liberalization, doing so within the same empirical framework as the growth effects. This produces a more complete picture of the effects of financial liberalization, and enables us to evaluate its overall welfare impact. Second, while the Rajan-Zingales methodology makes it possible to identify the *differential* impact of financial liberalization across industries, it does not allow one to estimate the *overall* effect of financial liberalization. This approach is thus of limited usefulness when it comes to policy evaluation of financial liberalization reforms. By contrast, our paper proposes a methodology to measure the overall effect. Third, we establish whether or not the effects of financial liberalization are temporary or permanent. And finally, we use both de facto and de jure measures of financial liberalization to assess robustness of the results. In particular, de facto measures have not previously been used in industry-level analysis.[7]

The rest of the paper is organized as follows. Section 2 describes the data. Section 3 lays out the empirical methodology and presents the estimating equations. In particular, we detail two alternative estimation strategies. One is based on de facto measures of liberalization, while the other relies of dating liberalization events, and therefore on de jure measures. Section 4 presents the results. Section 5 develops a framework to quantify the welfare implications of our estimates. Section 6 concludes.

2 Data

Industry-level production, employment, investment, and the number of establishments come from the 2006 UNIDO Industrial Statistics Database. This paper uses the version that reports data according to the 3-digit ISIC Revision 2 classification for the period 1963–2003 in the best cases. There are 28 manufacturing sectors, plus the information on total

[7] A small number of studies attempt to measure the effect of financial liberalization by using firm-level data for several countries. Henry (2000a, 2000b) finds that stock market liberalizations are associated with a reduction in the cost of capital, followed by an investment boom in a sample of listed firms in 12 emerging markets. Also using listed firms, Mitton (2006) finds that firms with stocks that are open to foreign investors experience higher growth, greater profitability, and improved efficiency. Alfaro and Charlton (2006) use a large cross-section of both listed and non-listed firms in 1999 and 2004 to show that international financial integration fosters the entry of new firms, a finding in line with our industry-level results.

manufacturing. We use data reported in current U.S. dollars, and convert them into constant international dollars using the Penn World Tables (Heston, Summers, and Aten, 2002).[8] The resulting dataset is an unbalanced panel of 56 countries, but we ensure that for each country-year we have a minimum of 10 sectors, and that for each country, there are at least 10 years of data.

We use two measures of de facto financial liberalization. The first is the gross capital flows as a share of GDP. The gross capital flows are the sum of gross inflows and gross outflows, obtained from the IMF's Balance of Payments Statistics. This measure, which is parallel to the aggregate trade openness (exports plus imports), has been used by Kose, Prasad, and Terrones (2003), as well as several subsequent papers.[9] The data on de jure financial liberalization come from Kaminsky and Schmukler (2007) (henceforth KS), who provide indices of liberalization in the stock market, the banking system, and freedom of international transactions for 28 countries. Along each of the three dimensions of liberalization, KS assign a value of 1, 2, or 3 for each country and year, with 3 indicating the most liberalized. They also provide a composite index, which is a mean of the three subcomponents.

In order to test for the differential effect of financial liberalization across industries, we employ the dependence on external finance measure introduced by Rajan and Zingales (1998). The Rajan and Zingales measure is defined as capital expenditure minus cash flow, divided by capital expenditure, and is constructed based on U.S. firm-level data. Intuitively, it is intended to capture the share of investment that must be financed with funds external to the firm.[10] We also make use of the industry-level measure of liquidity needs compiled by Raddatz (2006), defined as inventories as a share of sales. A sector has a higher need for liquidity when a smaller fraction of inventory accumulation can be financed by ongoing cash flow. Additional controls include financial development – private credit as a share of GDP – sourced from Beck, Demirgüç-Kunt, and Levine (2000), and trade openness at the industry level constructed by di Giovanni and Levchenko (2007).

Appendix Table A1 lists the countries in the sample and the summary statistics for growth, volatility, and gross capital flows for each country, as well as the means and standard

[8] Using the variable name conventions from the Penn World Tables, this deflation procedure involves multiplying the nominal U.S. dollar value by $(100/P)*(RGDPL/CGDP)$ for output, and $(100/P)*(KI/CI)*(RGDPL/CGDP)$ for investment to obtain the deflated value.

[9] We check the results by using instead a measure of stocks of gross foreign assets and liabilities from Lane and Milesi-Ferretti (2006). The results are robust to this alternative index of de facto liberalization, and we do not report them to avoid unnecessary repetition.

[10] We use the version of the variable assembled by Klingebiel, Kroszner, and Laeven (2007), in which industries are classified according to the 3-digit ISIC Revision 2 classification.

deviations for the entire sample. Table A5 in the supplementary web appendix lists the sectors used in the analysis, along with the values of external finance dependence and liquidity needs.

3 Empirical Methodology

3.1 The Models Based on De Facto Measures

We estimate the following specification:

$$GROWTH_{ict} = \beta FINLIB_{ct} + \gamma X_{ict} + \Delta + \varepsilon_{ict} \quad (1a)$$

$$VOLATILITY_{ict} = \beta FINLIB_{ct} + \gamma X_{ict} + \Delta + \varepsilon_{ict}. \quad (1b)$$

Here and throughout the paper, c indexes countries, i industries, and t time periods. The sample is a non-overlapping panel of 10-year averages, 1970-79, 1980-89, 1990-99, thus the subscript t refers to decades. On the left-hand side is either the 10-year average growth rate of a variable ($GROWTH_{ict}$), or the standard deviation of that growth rate calculated over the 10 year span ($VOLATILITY_{ict}$). X_{ict} is a vector of controls, that includes the beginning-of-period share of the sector in total output, log of beginning-of-period output per worker in the sector, as well as exports and imports as a share of output in the sector.[11] In addition, X_{ict} includes a measure of financial development (private credit as a share of GDP), as well as the interaction between the country's financial development and the Rajan-Zingales measure of dependence on external finance. These are meant to control for the well-documented differential growth effects of financial development. Appendix Table A3 presents the correlation matrix for the independent variables. Both specifications include a set of fixed effects Δ. The ability to employ a variety of fixed effects is a major strength of our empirical approach, as these can potentially control for a wide range of omitted variables. The use of fixed effects becomes especially powerful in a three-dimensional panel, which makes it possible to use interacted effects, such as country×sector, or sector×time.

Because the financial liberalization variable varies at the country×time level, in the specification above we cannot include country×time effects that would capture any other time-varying country characteristics not picked up by the controls. An alternative approach is to exploit sector-level characteristics in the spirit of Rajan and Zingales (1998) to identify a causal relationship between financial liberalization and outcomes. We therefore estimate

[11] We use beginning-of-period values rather than period averages for share and output per worker to avoid inducing a mechanical correlation with the left-hand side variable: a faster-growing sector will tend to have higher share in the contemporaneous period.

the following specifications:

$$GROWTH_{ict} = \beta CHAR_i * FINLIB_{ct} + \gamma X_{ict} + \delta_{ct} + \delta_{it} + \varepsilon_{ict} \quad (2a)$$

$$VOLATILITY_{ict} = \beta CHAR_i * FINLIB_{ct} + \gamma X_{ict} + \delta_{ct} + \delta_{it} + \varepsilon_{ict}. \quad (2b)$$

The dependent variables, $GROWTH_{ict}$ and $VOLATILITY_{ict}$, are as defined above. $CHAR_i$ refers to the industry characteristic used in estimation. This characteristic is either the Rajan and Zingales measure of dependence on external finance, or the Raddatz measure of liquidity needs. X_{ict} is a vector of controls. All of the specifications include a full set of country×time effects δ_{ct}, as well as sector×time effects δ_{it}. The country×time effects absorb any omitted time-varying country characteristics, such as reforms, changes in political regimes or governments, and many others. Thus, this empirical model identifies the effect of financial liberalization purely from its differential impact across industries within a country.

The Rajan and Zingales-type approach is a common one in the literature, indeed we are not the first to analyze the growth effects of financial liberalization with this strategy (though we are the first, to our knowledge, to address the issue of volatility). It is important to emphasize the pros and cons of model (1) compared to (2). The disadvantage of the former is that it may suffer from an omitted variables problem, because of our inability to include country×time effects. Its main advantage is that it allows us to estimate the direct effect of financial liberalization on the average growth and volatility across sectors within a country. By contrast, the omitted variables problem is overcome in the Rajan-Zingales-type model. However, its key shortcoming is that because it relies solely on the within-country cross-industry variation, it does not allow the researcher to identify the magnitude of the overall effect. That is, the growth effect of financial liberalization – the object of much study using the cross-country regression approach – is subsumed in the country×time fixed effect.

3.2 The Models Based on De Jure Measures

In our second approach to estimating the effects of financial liberalization, we date the liberalization events in a sample of countries, and then compare outcomes before and after liberalization. This strategy relies on the de jure indicators compiled by KS to identify the liberalization episodes. Because we require precise liberalization dates, we must set a threshold for the KS index, above which the country is considered liberalized, and below which it is not.[12] The resulting set of liberalization dates is listed in Appendix Table A2.

[12] Whenever the financial liberalization index used is not binary, an important question is how to define a financial liberalization event. In the baseline regressions we classify a country as liberalized whenever all

For each episode, we compute the left-hand side variable, as well as the relevant controls, for the 10-year period before, and the 10-year period after the liberalization date.

To estimate the effects of financial liberalization on economic outcomes, we use a conventional difference-in-differences model. For each liberalization episode, we identify a control group of countries from among those that did not liberalize during the 20-year period around the liberalization date. Intuitively, while the Rajan-Zingales-type model uses non-financially intensive sectors as a control group for the financially intensive sectors, this empirical strategy uses non-liberalizing countries as a control group for the liberalizing country.

In particular, we estimate the following set of specifications:

$$GROWTH_{ict} = \beta_0 POST_t + \beta_1 TREATED_{ct} + \gamma X_{ict} + \Delta + \varepsilon_{ict} \quad (3a)$$

$$VOLATILITY_{ict} = \beta_0 POST_t + \beta_1 TREATED_{ct} + \gamma X_{ict} + \Delta + \varepsilon_{ict}, \quad (3b)$$

where $POST_t$ is the variable taking on the value of 0 before the liberalization episode, and 1 after. $TREATED_{ct}$ is a binary indicator for whether a country is liberalized in a given period. Note that by construction, in this model t takes on only two values: before liberalization, and after it. Model (3) is the "classic" difference-in-differences specification. The left-hand side variable is measured in two periods, before and after treatment. The right-hand side includes a variable $POST_t$, that indicates whether the observation is from before or after treatment. It is common to both treated and control observations. Finally, the coefficient of interest β_1 is on the variable $TREATED_{ct}$.

The key question is what countries to assign to the control group for each liberalization episode. This paper pursues two strategies. First, for each episode we use as the control group all of the countries that did not liberalize around the same time as the liberalizing country. This procedure can result in a large number of heterogeneous countries constituting each control group. To refine this procedure one step, we only use OECD countries as available controls for the OECD liberalizers, and non-OECD countries as possible controls for the non-OECD liberalizers. The advantage of this approach is that it uses a large amount of information for what is happening in various non-liberalizing countries around the time of each liberalization episode. The disadvantage is that besides the coarse OECD/non-OECD refinement, no attempt is made to use country characteristics in picking the control groups. Potentially, this can result in the control group countries having very different characteristics from the treated ones for each episode. Note that the large size of the control groups should help in this respect, since the country heterogeneity would be averaged out among the large

three components of the index – domestic, capital account, and stock market – indicate full liberalization. This approach emphasizes the complementarities between the different financial liberalization reforms.

number of control countries. Also, many of the obvious differences, such as the overall level of development, that can arise between a treated country and its control, would be accounted for by the country fixed effects included in the estimation.

Nonetheless, potential selection concerns remain. In order to overcome them, we also employ a propensity score matching procedure (henceforth PSM) to find a suitable control group. The supplementary web appendix to this paper describes it in detail. The PSM procedure seeks to use information on observable characteristics of subjects to estimate a probability model for being treated. Then, for each instance of a treated observation, it uses the information on the observables to identify a non-treated observation closest to the treated one. That non-treated observation then becomes the control group for the treated one. The first economic applications of the propensity score techniques are due to Dehejia and Wahba (1999, 2002). The PSM methods were first used in international economics by Persson (2001) and Glick, Guo and Hutchinson (2006). Though it has been applied widely in various empirical analyses, it must be kept in mind that the PSM method corrects only for selection on observables, not unobservables. Furthermore, it can be sensitive to the set of conditioning variables used to predict propensity scores (see Smith and Todd, 2005).

4 Results

4.1 Growth and Volatility

Table 1 reports the results of estimating equation (1a), in which the dependent variable is the average 10-year growth rate of total real output in a sector, and the independent variable of interest, $FINLIB$, is the average gross capital flows over the same 10-year period. Because $FINLIB$ is measured at country×time level, we cluster the standard errors at the country×time level as well. The first four columns add progressively more fixed effects. Column 1 includes country, sector, and time effects separately. Column 2 uses instead country and sector×time fixed effects. Column 3 adds country×sector and time effects. Note that in this column, identification comes purely from the time series variation in the variables of interest. Column 4 includes country×sector and sector×time fixed effects. This is the most stringent possible array of fixed effects (in terms of remaining degrees of freedom) that can be included in this specification. We can see that the financial openness variable has a positive effect on the growth rate of total output.

Among the other controls, the most significant ones are the initial share in total output and the initial output per worker, which have a negative sign. We interpret this as a standard convergence effect: sectors that are already large and established experience less

growth in the subsequent period. Trade openness and financial development on its own do not appear to be robustly significant. The Rajan-Zingales term – private credit interacted with external finance dependence – has the expected sign but is not significant when we include the country×sector effects. This is sensible as well: as long as financial development is stable across the time periods, the Rajan-Zingales interaction term will be approximately spanned by the country×sector effects. The magnitude of the coefficient of interest is economically significant. A one standard deviation change in de facto financial openness is associated with a 1.3 percentage points increase in the output growth rate, a change of 0.16 standard deviations.

In order to go further in identifying the causal impact of financial liberalization on growth, we next estimate a version of equation (2a). In this specification, $FINLIB$ is interacted with the Rajan-Zingales measure of dependence on external finance. We include sector×time and country×time fixed effects, controlling for other changes – such as reforms – that occur at country level and differ across time. Note that this makes it impossible to estimate the effect of $FINLIB$ on growth, but enables us to make a statement about its differential impact across sectors. When we do so, the coefficient on the interaction term is highly significant. It does seem to be the case that more financially dependent sectors grow faster as a result of liberalization than less financially dependent sectors. When we do the same with the Raddatz measure of liquidity needs, we find a positive coefficient but it is not significant.

Next, we analyze the effect of financial liberalization on volatility. The models (1) through (3) are the same for volatility as they were for the growth results above. Unless otherwise indicated, we use the same specifications, controls, and configurations of fixed effects throughout for maximum comparability. Table 2 presents the panel estimates. The first 4 columns of Table 2 present the results of estimating equation (1b), with the standard deviation of the growth rate of output as the dependent variable. The only difference compared to the specification of equation (1a) is that instead of interacting private credit with the Rajan-Zingales measure of external finance dependence, we interact it with the Raddatz measure of liquidity needs instead. Raddatz (2006) finds that volatility in a sector responds to financial development differentially depending on its liquidity needs. In the volatility specifications we thus control for this effect.[13] $FINLIB$ has a positive effect on volatility for all configurations of fixed effects, though the level of significance is at the

[13] We also controlled for the interaction of financial development with the Rajan-Zingales measure instead, as we do in the growth estimations. The results were unchanged.

10% level in most specifications. The magnitude of the impact of $FINLIB$ on volatility is economically significant. A one standard deviation change in $FINLIB$ is associated with a rise in the standard deviation of sector-level growth rate of 1.6 percentage points, equivalent to a movement of 0.13 standard deviations of the sectoral volatility in the sample.

Columns 5 and 6 estimate equation (2b), which interacts $FINLIB$ with the Rajan and Zingales measure of dependence on external finance and the Raddatz measure of liquidity needs. For both sector characteristics, the results are significant. Higher levels of $FINLIB$ increase volatility more in sectors that depend more on external finance, or with higher liquidity needs.

In sum, the panel estimates using the de facto measures financial integration reveal that it increases both growth and volatility. Interestingly, the effects on growth and on volatility are of similar order of magnitude. Both are magnified in sectors that are more dependent of external finance, suggesting that those sectors are growing faster in part thanks to higher leverage in the post-liberalization period. In contrast, the sectoral liquidity needs seem to play an important role in the volatility increase within a 10 year period but do not seem to affect the growth prospects at a 10 year horizon.[14]

Next, we present here the results of estimating model (3), which is based on the de jure indicators. We estimate equation (3a), with the average growth rate of output over the 10-year period as the dependent variable. As we cannot use country×time effects, we experiment with various configurations of fixed effects to control for omitted variables. Because financial liberalization occurs as country×time level, we cluster the standard errors at country×time level as well, in order to avoid biasing the standard errors downwards.

Table 3 presents the results. The first four columns use all available countries as control groups. Column 1 presents estimation results with country fixed effects, while column 2 uses country×sector fixed effects. Column 3 uses country and group×time fixed effects, where we define a "group" to be a single liberalizing country plus all its control countries. The group×time effects control for the time variation in the variables affecting both the treated and the control countries, such as the changes in the global conditions. Finally, column 4 uses the country and group×sector fixed effects. The latter is the same as using sector fixed effects, but within each individual group (as, for example, the sector effects may

[14] How do our volatility results compare to the existing estimates? The literature using cross-country data has focused on the volatility of aggregate consumption rather than output. Even for aggregate consumption, the results are inconclusive: while Kose, Prasad, and Terrones (2003) find, paradoxically, that financial integration increases consumption volatility, Bekaert, Harvey, and Lundblad (2006) find the opposite. Glick, Guo, and Hutchinson (2006) demonstrate that financial integration reduces the likelihood of currency crises. However, these results are not directly comparable to ours, as currency crises are a different object than the year-on-year volatility studied here.

change over time).

We can see that financial liberalization has a robust positive effect on growth of output across sectors. This effect is present across all configurations of fixed effects except one, and its magnitude is stable as well. The last four columns use the PSM procedure to select, for each liberalizing country, a control country based on observable characteristics. The different columns include different configurations of fixed effects, in the same sequence as the first four columns. Using the PSM control group, we still find a robust positive effect, significant at 1% in all cases.

The magnitude of the effect is large. A financial liberalization, captured by moving the $TREATED$ variable from 0 to 1, is associated with a sector-level growth rate that is between 1.5 (full control group) and 3.5 (PSM control group) percentage points higher. This is equivalent to 0.17 and 0.40 of a standard deviation of the 10-year average sector-level growth rate observed in the sample. Note that this effect is larger than the estimated effect of a one-standard deviation change in de facto openness estimated above. The two measures of financial liberalization are not directly comparable, however. It could be, for instance, that a typical de jure episode we analyze is equivalent to a more than one standard deviation change in de facto openness.

Table 4 presents the results of estimating equation (3b) using the volatility of the growth rate of output. The first four columns use the full control group, while the second column uses the PSM group. The columns differ in their use of fixed effects, identically to the estimates of growth effect of financial liberalization in Table 3. Once again, financial liberalization appears to increase volatility, as the coefficients of interest with both the full and the PSM control groups are positive and significant in all but two cases. The coefficient is stable across the control groups and fixed effects configurations. It implies that a financial liberalization event is associated with a rise in the standard deviation of sectoral growth of 2.3 percentage points, or 0.2 standard deviations of volatility found in the sample. Just as we had found with the growth results, the impact of a de jure liberalization is larger than that of increasing de facto capital flows by one standard deviation.

We also use the de jure indicators to estimate the effect of financial liberalization in two alternative ways. First, we use the KS index in place of the de facto measures in model (1). And second, we employ an alternative difference-in-differences model based the differences in sector characteristics similar to model (2). The results, reported in Tables A6 and A7 in the supplementary web appendix to this paper, are robust to these alternative estimation strategies.

4.2 Factor Accumulation vs. Total Factor Productivity Growth

We next investigate the channels through which financial liberalization increases the growth rate of output. We would like to know whether it is associated with greater entry (the number of firms). Furthermore, as in a standard growth accounting framework, growth in total production can come from increased employment, capital accumulation, and growth in total factor productivity (TFP). We use the standard techniques to construct the capital stock and a TFP series for each country and sector (see, for example, Hall and Jones, 1999). The capital stock in each year t is given by $K_{ict} = (1-\delta)K_{ict-1} + I_{ict}$. We take a depreciation rate $\delta = 0.08$, and adopt the standard assumption that the initial level of capital stock is equal to I_{ic0}/δ. We then follow Jorgenson and Stiroh (2000) to compute total factor productivity at the industry level. Log of TFP in year t is equal to $\ln TFP_{ict} = \ln Y_{ict} - (1-\alpha_{ic}) \ln L_{ict} - \alpha_{ic} \ln K_{ict}$, where Y_{ict} is the total output, and L_{ict} is the total employment in the sector. Each sector in each country has its own labor share α_{ic}, computed as the average of the total wage bill divided by value added.[15]

In Table 5, we investigate the effect of financial liberalization on each of these components of overall growth using the de facto indexes. Column 1 presents the estimates of equation (1a) in which the dependent variable is the growth rate in the number of establishments. The column includes the most stringent set of fixed effects – country×sector and sector×time – and clusters the standard errors at country×time level. Column 2 estimates equation (2a) with the same left-hand side variable. We can see that a higher level of $FINLIB$ has a positive and significant effect on the growth rate of the number of establishments. Also, the effect seems stronger in more financially intensive sectors, as evidenced in Column 2.

Columns 3 and 4 repeat the exercise for the growth rate of employment. Similarly to the number of establishments, $FINLIB$ is associated with higher total employment growth, and there is some evidence that more financially dependent sectors experience relatively higher employment growth. Columns 5 and 6 examine instead the capital accumulation, defined as the growth rate of the capital stock. It is clear that the effect of financial liberalization on capital accumulation is strong, and it does affect the more financially dependent sectors differentially. Finally, columns (7) and (8) examine TFP growth. The coefficients are close to zero and not statistically significant.

[15] Alternatively, we applied to all countries the labor share in sector i in the U.S., or the average labor share in sector i across all countries in the sample. We also used labor productivity (value added per worker) instead of TFP. The results were unchanged.

Table 6 presents the results of the channel decomposition of the growth effects in the difference-in-differences model using de jure liberalization indexes. All of the specifications are presented only with country and group×time fixed effects, though the results are robust across the various fixed effects configurations. The first two columns present the results for the growth rate in the number of firms. The evidence here is mixed. While the full control group sample produces zero effect, when we select the control group with the PSM procedure, it turns out that the effect of financial liberalization on entry is strongly positive. When it comes to employment (columns 3 and 4), we see that here we have our most robust results: the growth rate of sector-level employment increases with financial liberalization. Columns 5 and 6 investigate the effect of financial liberalization on capital accumulation. The effect is positive and robustly significant. Finally, once again there does not appear to be a robust positive effect of financial liberalization on TFP. In one of the specifications it is not significant, while in the other there is a positive and marginally significant coefficient.[16]

4.3 Temporary vs. Permanent Effects

This paper uses a variety of empirical strategies to document the effect of financial liberalization on growth, volatility, and the various subcomponents of output at a 10-year horizon. Going much beyond 10 years would be impractical, as there aren't many liberalization episodes in the sample that occurred more than 10 years before our data ends. However, we can still investigate whether the magnitude of the effect of financial liberalization changes over time. This will allow us to establish whether the impact of liberalization on various outcomes is short-lived, or has a chance to be long-lasting.

In this section, we break the post-liberalization periods into 3-year intervals: 0-2, 3-5, 6-8, and 9-12 years, and use the difference-in-difference model (3) with the PSM control group to estimate the treatment effect (β_1) for each 3-year period after liberalization. Examining these coefficients will tell us at which lag the effect of financial liberalization is at its strongest. Figure 2 presents the results. It plots β_1 over time, along with the 90% confidence intervals.

The top panel of Figure 2 presents the timing of the growth effects. It is clear that the positive effect of financial liberalization occurs early in the sample: the first 6 years.

[16] We do report here the decomposition of the volatility results into channels as we did with the growth results above. While in growth accounting the growth rates of each component of the production function add up to the total, the volatilities of the subcomponents do not add up to the volatility of the total because of the covariances among the subcomponents. Thus, it is not as informative to report the effect of financial liberalization on each subcomponent, and may be misleading as to what is responsible for the overall effect if the covariances are also changing. Results are nevertheless available upon requests.

At longer lags, the effect of financial liberalization on growth becomes muted and not statistically significant. However, compounding the growth effects over time reveals a large *level effect*: at a 12 year horizon, the output of the typical liberalized economy exceeds the output of its non-liberalized counterpart by 23 percent. The time pattern also indicates that the growth effect in the post-liberalization period is highly non-stationary: growth rises on impact, accelerates further 3 to 5 years after liberalization, and then decelerates to reach zero at the end of the 12 year period. An interesting question is how much of the increase in growth volatility within 10 years found in Section 4.1 is due to the non-stationarity of the growth transition. To measure this, we compute the increase in growth volatility implied by the time evolution of the growth effects. We find that it amounts to 1.8%, a figure only slightly lower than the average post liberalization effect for volatility in the 10 year window presented in Table 4 (2.22%).

The right panel of Figure 2 presents the timing of the volatility effects. Note that we measure the impact of financial liberalization on short-run growth volatility *within* each 3-year interval, abstracting from the impact of change in growth *between* intervals discussed above. We find that the growth volatility experiences a sharp increase in the immediate aftermath of financial liberalization. This effect is reduced over time but remains positive. In the last interval – 9-12 years – the effect on volatility is equal to 1.7%, though it is not statistically different from zero (p-value of 15.6%). Therefore, we cannot definitively rule out that there is a permanent increase in short-run volatility on top on the temporary increase in medium-run volatility resulting from the growth transition.

How does financial liberalization affect the subcomponents of total output analyzed in this paper? Figure 3 presents the timing of the effects for each channel affecting growth.[17] Panel 1 presents the treatment effect on the growth of the number of establishments. There is a positive effect in the short run, same as for the total output.[18] Panel 2 presents the results on employment growth. These mirror the overall output results: a positive and significant short-run effect, becoming muted at longer lags. The results for capital accumulation growth are presented in Panel 3. What is interesting here is that the effect of financial liberalization is both longer-lasting, and increasing over time, until the 9th year or so after liberalization. Thus, the capital accumulation effects are more persistent than the other outcomes, and, since capital apparently adjusts slowly, take longer to attain the

[17] For the reasons mentioned in footnote 14, we choose not to report the duration graph for the volatility effects. This figure is available upon request.

[18] The results for the number of firms are not presented for the last period (9-11 years), as the coverage for the number of firms is more sparse than for other variables, and thus there are not enough observations to obtain a reliable last period estimate.

full effect. Unlike the output and employment effects, the effect of financial liberalization on capital accumulation is still positive at the longest lag, but it is not significant due to substantially widened error bands. Panel 4 presents the TFP chart. Consistent with the regression results from almost all of our specifications, there is no persistent effect of financial liberalization on TFP growth. It is only in the first two periods that TFP growth increases significantly. To see whether there is an effect on the *level of TFP* at 10 year horizon, we compound the point estimates for each subsequent three-year interval. We find a cumulative level effect on TFP close to zero.

Finally, panel 5 considers another outcome, the level of the price-cost margin. It is defined as follows:

$$PCM = \frac{value\ of\ sales - wages - cost\ of\ inputs}{value\ of\ sales},$$

and is meant to capture the size of markups, and thus the competitiveness of the industry (see Braun and Raddatz, 2007).[19] The effect of financial liberalization on the price-cost margin is negative and significant, quite pronounced, and appears persistent. We call this reduction in markups the pro-competitive effect of financial liberalization.

The finding of a reduction in the markups can, in part, explain why we find a permanent effect on the level output without any detectable effects on TFP. Since the presence of markups introduces a wedge between the marginal product of capital and the rental rate of capital, their reduction can lead to a higher steady-state level of capital and output, as shown by Galí (1994, 1995). Such a permanent effect on the level of output is also likely to result in much larger welfare gains from financial liberalization than the ones implied by the standard neoclassical model (Gourinchas and Jeanne, 2006). We explore this feature in the next section of the paper.

A general feature of our results is the apparent lack of significant effects of financial liberalization on total factor productivity growth. These results should be interpreted with caution, as the construction of TFP may be subject to several measurement biases. First, we do not have direct information on the use of intermediate inputs in sectoral production. The direction of the resulting bias is hard to assess since it depends on the change in the use of intermediate inputs relative to the other factors of production.[20] Second, as shown by Hall

[19] The PCM is essentially a measure of profitability, or the flow accrued to owners of capital. Though imperfect as a measure of markups, it has the advantage of simplicity, and has been widely used in the literature. It is also highly correlated to other indicators of competitiveness, such as industry concentration ratios (see, e.g., Domowitz, Hubbard, and Petersen, 1986). Furthermore, note that our empirical strategy relies on the time variation in this index. Thus, to the extent that mismeasurement occurs mainly in the cross-section of countries or industries rather than differentially over time, the results are still informative.

[20] In particular, the fact that a large number of industrial sectors produce intermediate inputs and have

(1988), a change in the Solow residual under imperfect competition can reflect both a change in total factor productivity and a change in markups. Note that a reduction in markups – suggested by the observed reduction in the price-cost margin following liberalization – would if anything bias our results in favor of finding a positive TFP effect.[21,22] Finally, beyond measurement issues, our results are consistent with the recent findings of Hale and Long (2007) on the lack of productivity spillovers on domestic firms stemming from foreign direct investment flows.

5 Aggregation and the Welfare Impact

Armed with point estimates of how financial liberalization changes sector-level growth and volatility, we can now calculate what these estimates imply for the aggregate economy. In a country comprised of sectors $i = 1, ..., I$, the aggregate growth rate can be written as:

$$y_A = \sum_{i=1}^{I} a_i y_i, \tag{4}$$

where a_i is share of sector i in the overall output of the country, and y_i is the growth rate of sector i. This paper estimates the change in sector-level growth rate Δy, that comes as a result of financial liberalization. The change in the aggregate growth rate could be obtained from (4) in a straightforward manner:

$$\Delta y_A = \sum_{i=1}^{I} a_i \Delta y = \Delta y.$$

That is, if each sector's growth rate increases by Δy, then the aggregate GDP growth will rise by the same amount.

experienced higher growth following liberalization – possibly suggesting a higher demand for intermediates from other industries – is not directly informative of the direction of the bias in measured TFP growth.

An alternative method is to derive total factor productivity growth from value added instead of output. This approach has the advantage of controlling for the role intermediate inputs but it requires separability between the value added production function and intermediate inputs, a condition generally not met in industry-level data (see Jorgenson et al., 1987). We nevertheless computed an alternative measure of TFP based on value added and the results were unchanged.

[21] Using a fully specified model, Jaimovich (2007) shows that "true" TFP growth ($\hat{z}$) is related to the change in the markups ($\hat{\mu}$) and the Solow residual (SR) as follows:

$$\hat{z} = SR + \hat{\mu}.$$

Since our measure of TFP is the Solow residual, a reduction in markups – negative $\hat{\mu}$ – implies that the "true" change in TFP is actually lower than our estimates, not higher.

[22] See Hsieh and Klenow (2007) for a comprehensive analysis of the effect of distortions on sectoral TFP in China and India.

When it comes to volatility, equation (4) implies that the change in the standard deviation of aggregate output is equal to:

$$\Delta\sigma_A = \sqrt{\sum_{i=1}^{I} a_i^2 \Delta\sigma^2} = \sqrt{h}\Delta\sigma,$$

where $\Delta\sigma$ is the estimated impact of financial liberalization on sector level volatility, and $h \equiv \sum_{i=1}^{I} a_i^2$ is the Herfindahl of production shares in the economy.[23] In contrast to the growth increase, the change in sector-level volatility is moderated by the Herfindahl index of production shares in the economy. Thus, for any given change in sector-level volatility, the increase in aggregate volatility is much lower. For instance, the average value of h in our sample is 0.087, which implies that the change in the aggregate volatility is about one third of the magnitude of the change in sector-level volatility: $\Delta\sigma_A = 0.29 * \Delta\sigma$.

We now evaluate the impact of financial liberalization on welfare, following Lucas (1987). Specifically, we calculate the Hicksian equivalent variation λ: the percentage increase in average consumption in an economy without financial liberalization which would leave an agent indifferent from an increase in consumption growth and volatility induced by financial liberalization.[24]

The distinction between the sector-level and the aggregate change in volatility will matter for welfare. Following on the aggregation discussion above, we perform the welfare analysis under two polar assumptions on domestic asset markets. First, we posit that volatility faced by the agents increases by the same amount as the change in the sector-level volatility we estimated. This is the welfare impact in a world where each agent derives all her income from a single sector, and does not diversify income risk across the different sectors at all. We view this as the most pessimistic scenario regarding the negative welfare impact of volatility, because some income risk sharing across sectors surely does exist, though it is highly incomplete even in the most developed economies (Attanasio and Davis

[23] This assumes that liberalization does not have a significant effect on the covariances between the sectors in the economy, which appears to be the case in our data.

[24] An important difference between our calculations and Lucas's is that we equate consumption with income – the object we can study in our data. This is a shortcoming because it rules out intertemporal self-insurance. In a similar exercise to ours, Krebs et al. (2005) justify this by assuming a model economy with borrowing constraints, no initial period assets, and a market-clearing interest rate. When it comes to sharing risks internationally, evidence suggests that even in developed countries consumption behaves in ways not consistent with complete output risk sharing (Backus, Kehoe and Kydland 1992, Kehoe and Perri 2002). For developing countries, the problem is likely to be even more severe, as these countries typically experience current account behavior that on the face of it is inconsistent with consumption smoothing (Kaminsky, Reinhart and Vegh 2005). Thus, evidence suggests that countries do not, to a first approximation, use international markets to insure their output risks. Both intertemporal consumption smoothing and possible international risk sharing will reduce the detrimental impact of increased output volatility. In this sense, our estimates can be thought of as the lower bound for the welfare effect of financial liberalization.

1996, Hayashi et al. 1996). Second, we instead assume perfect risk sharing across sectors, and evaluate the welfare impact of financial liberalization on the aggregate volatility. We view this as the most optimistic scenario for the welfare impact on the average agent, as it assumes that her income is derived from a perfectly diversified portfolio across sectors in the economy.

Following Lucas (1987) we assume a CRRA utility function of an infinitely-lived consumer with a relative risk aversion γ and a discount factor β:

$$U(\{\tilde{c}_t\}, \lambda) = E_0 \left\{ \sum_{t=0}^{\infty} \beta^t \frac{[(1+\lambda)\tilde{c}_t]^{1-\gamma} - 1}{1-\gamma} \right\}. \tag{5}$$

We are interested in finding the compensating variation in λ required to keep the agent indifferent between the consumption stream experienced after financial liberalization $\{\tilde{c}_t\}^{FL}$ and the consumption stream, $\{\tilde{c}_t\}^{\varnothing}$ expanded by $(1+\lambda)$, corresponding to the counterfactual scenario in which no financial liberalization occurs at date 0. Specifically we calculate the value of λ that solves the following equation:

$$U(\{\tilde{c}_t\}^{\varnothing}, \lambda) = U(\{\tilde{c}_t\}^{FL}, 0).$$

For both $j \in \{\varnothing, FL\}$, we assume that the consumption path is separable in a deterministic trend c_t^j with a growth rate μ_t^j and a stochastic disturbance $\tilde{\eta}_t^j$ such that:

$$\tilde{c}_t^j = c_t^j \tilde{\eta}_t^j$$

$$c_t^j = (1 + \mu_t^j) c_{t-1}^j$$

$$\ln(\tilde{\eta}_t^j) = \rho \ln(\tilde{\eta}_{t-1}^j) + \tilde{\varepsilon}_t^j, \tag{6}$$

where $\tilde{\varepsilon}_t^j$ is a normally distributed shock with mean zero and a standard deviation σ_t^j. The standard assumption of lognormality of $\tilde{\eta}_t^j$ simplifies the computation of total discounted utility (5) and fits the data well.

As emphasized by Reis (2007), the welfare analysis is highly sensitive to the parameter ρ in the AR(1) process (6): a larger ρ means more persistence of past shocks and thus a greater negative welfare impact of volatility. Following Reis (2007), we consider two cases in our exercise: $\rho = 0$, $\rho = 0.7$. The first case corresponds to the original choice of Lucas (1987); the second case is based on estimating the process (6) on sector-level output growth in our data.[25]

[25] Reis (2007) finds that in the postwar period, $\rho = 0.84$ for the US aggregate consumption process.

The growth and volatility of the consumption process in the absence of financial liberalization, $\{\tilde{c}_t\}^{\varnothing}$, is based on the averages for the control (non-liberalizing) countries in the PSM sample. In the data, it turns out that the average growth rate in the absence of liberalization is $\hat{\mu}_t^{\varnothing} = 0.03$. The volatility of output at sector level without liberalization is $\hat{\sigma}_t^{\varnothing} = 0.118$. Under the scenario of perfect risk-sharing across sectors within the country, $\hat{\sigma}_{A,t}^{\varnothing} = \sqrt{h} * 0.118 = 0.034$. To compute the consumption path following financial liberalization we rely on the estimates in Section 4.3. We set $(\hat{\mu}_t^{FL}; \hat{\sigma}_t^{FL}) = (\hat{\mu}_t^{\varnothing} + \hat{\Delta}_t^{\mu}; \hat{\sigma}_t^{\varnothing} + \hat{\Delta}_t^{\sigma})$ where the changes $(\hat{\Delta}_t^{\mu}; \hat{\Delta}_t^{\sigma})$ correspond to the point estimates reported in Figure 2. Given that financial liberalization has only a transitory impact on growth (but potentially a permanent effect on volatility) we posit that $\forall t \geq 11, \hat{\Delta}_t^{\mu} = 0$.

Our estimates show that financial liberalization has a cumulative effect of 23,3% on the income level. The welfare gains will be lower for three reasons. First, the growth gains are delivered over time and should be discounted. Second and more importantly, financial liberalization brings two extra sources of volatility, thus reducing the welfare of a risk-averse agent: a temporary increase in medium-run volatility reflecting the non-linear transition towards a higher income level, and an increase in short-run volatility that may be permanent.

The results of our welfare analysis are reported in Table 7. Throughout, we assume that the discount factor $\beta = 0.95$. The table presents the calculation under two main scenarios for three values of risk-aversion – $\gamma = 1$, 2.5, and 5 – and two values for the persistence of the output shocks – $\rho = 0$ and $\rho = 0.7$. Panel A assumes perfect domestic risk-sharing across sectors. We assume, alternatively, that the increase in short-run volatility is only temporary or permanent. In the temporary case, the welfare gains range from 12.9% to 20%. While risk-aversion has a first order effect on welfare, the effect of the persistence of the consumption shock process is of second order magnitude. Panel B assumes no domestic risk-sharing so that each agent faces an increase in volatility as estimated at the industry level. The results differ sensibly from the first scenario. First, the welfare gains are smaller and this reduction gets bigger with a higher risk aversion and with a more persistent consumption shock process (note the latter effect is no longer of second order). For instance, the welfare gains for high risk aversion ($\gamma = 5$) and persistent shock ($\rho = 0.7$) are reduced by around one third compared to the first scenario (from 12.9% to 8.6% in the case of permanent volatility effects). Note that, as in first scenario, moving from temporary to permanent volatility effects does not make much difference.[26]

[26] The intuition behind such a small difference is that the effect of volatility beyond 12 years from the time

A striking feature of this welfare analysis is that the impacts are an order of magnitude higher than those found in the neoclassical model calibrated by Gourinchas and Jeanne (2006). The difference comes from the assumption in their study that financial liberalization has only temporary effects. Indeed in a neoclassical setting liberalization only speeds up the transition process toward a long run steady state, which remains unaffected by liberalization. This welfare analysis presents another view, as our estimation results clearly point to a permanent level effect of financial liberalization on the long run equilibrium.[27]

6 Conclusion

It is often argued, both theoretically and empirically, that financial liberalization should affect economic growth. At the same time, claims that financial liberalization increases volatility are made just as often. This paper uses a large panel of industry-level data to analyze both growth and volatility effects within the same empirical framework. A key strength of our approach is the number of alternative strategies we use to estimate these relationships. We use both de facto and de jure measures of liberalization, and employ a variety of difference-in-differences estimates. We exploit sector characteristics, use non-liberalizing countries as controls, develop a propensity score matching procedure to overcome selection on observables, and use a variety of fixed effects throughout to control for omitted variables. What is remarkable is that the conclusions are virtually the same across all empirical strategies.

There is strong evidence that financial liberalization increases both growth and volatility of output. Those effects are not long-lasting: they typically vanish after 6 years. When it comes to channels, we find that financial liberalization is accompanied by an increase in the growth of employment and capital formation. Furthermore, liberalization exerts procompetitive pressures on the product market: there is a transitory increase in the entry of firms and a permanent drop in the price to cost margin. By contrast, the growth rate of TFP does not seem to be affected by liberalization. Finally, though both growth an volatility increase following liberalization, we show that its net welfare impact is positive.

of liberalization would be highly discounted.

[27] Note that we only consider here the welfare consequences of "normal" volatility at business cycle frequency. See Ranciere, Tornell and Westermann (2007) for a framework in which financial liberalization also increases the risk of rare but severe financial crises.

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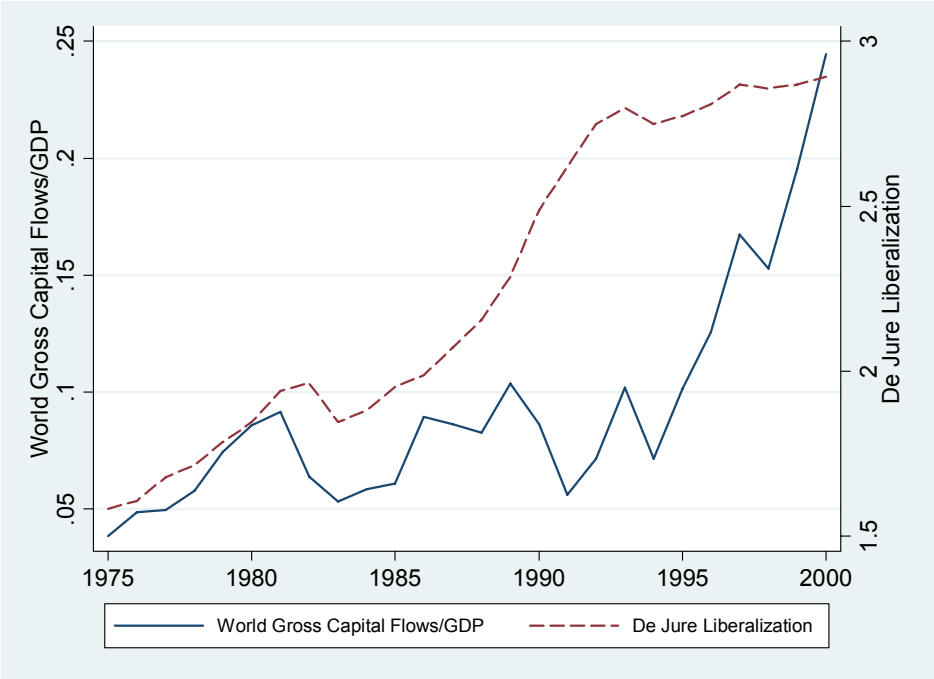
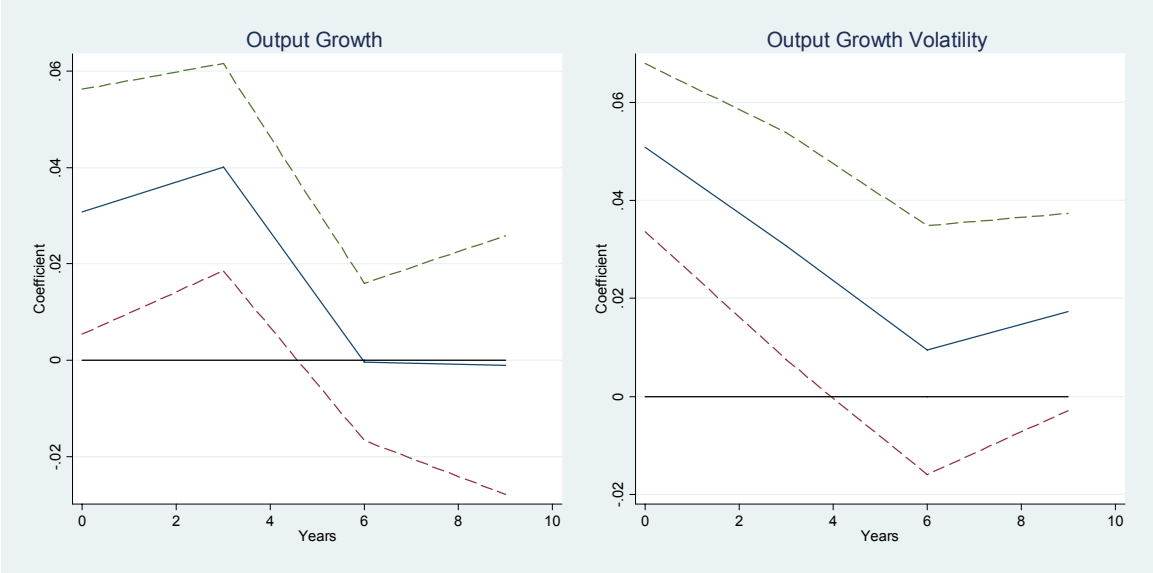
Figure 1: Worldwide Financial Liberalization Trends



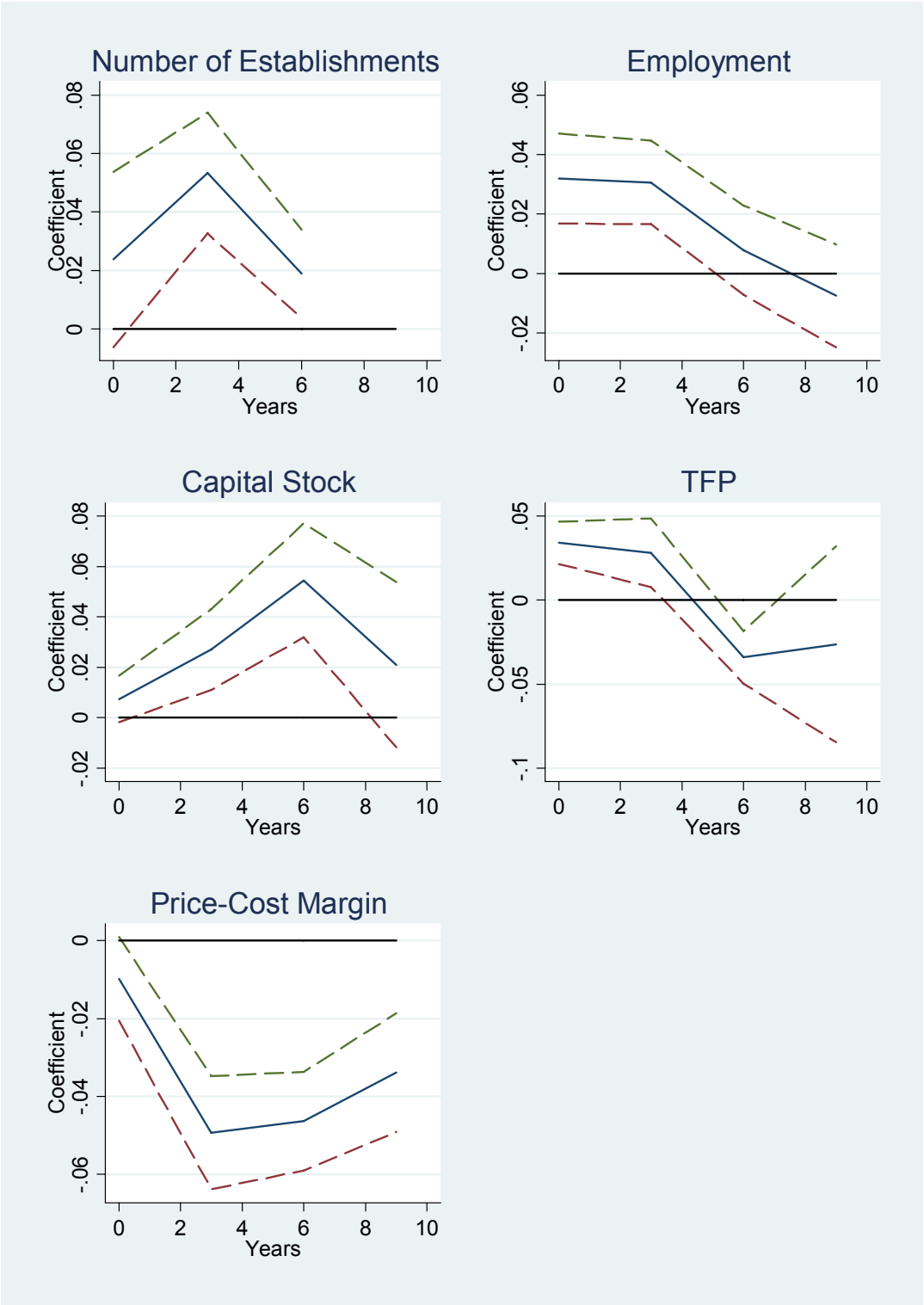
Notes: The World Gross Capital Flows/GDP are the sum of the gross capital flows across countries, divided by world GDP, in each year. Source: IMF Balance of Payments Statistics and World Bank's World Development Indicators. De Jure Liberalization is the average composite index of financial liberalization across countries in each year. The index ranges from 1 (least liberalized) to 3 (fully liberalized). Source: Kaminsky and Schmukler, (2007).

Figure 2: The Time Evolution of the Growth and Volatility Effects of Financial Liberalization



Notes: This figure depicts the treatment effect of financial liberalization for the outcome variables over time. The solid line is the coefficient on the *TREATED* dummy variable in the years 0-2, 3-5, 6-8, and 9-12 after the liberalization episode. Dashed lines represent the 10% significance bands.

Figure 3: The Time Evolution of the Effect of Financial Liberalization: Channels



Notes: This figure depicts the treatment effect of financial liberalization for the outcome variables over time. The solid line is the coefficient on the *TREATED* dummy variable in the years 0-2, 3-5, 6-8, and 9-12 after the liberalization episode. Dashed lines represent the 10% significance bands. All variables are in growth rates with the exception of the price-cost margin which is in level.

Table 1: De Facto Financial Liberalization and Growth, 10-year Panel Estimates

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.: Growth Rate of Output						
FINLIB	0.260***	0.259***	0.282***	0.286***		
	[0.066]	[0.066]	[0.092]	[0.091]		
FINLIB*Extern.Fin					0.187***	
					[0.061]	
FINLIB*Liq.Needs						0.445
						[0.411]
Log(Initial Output/Worker)	-0.015***	-0.014***	-0.036***	-0.036***	-0.013***	-0.013***
	[0.004]	[0.004]	[0.008]	[0.008]	[0.004]	[0.004]
Initial Share	-0.100***	-0.098***	-0.641***	-0.738***	-0.100***	-0.092***
	[0.028]	[0.029]	[0.118]	[0.128]	[0.029]	[0.029]
Exports/Output	0.001	0.002	-0.142	-0.160	0.020	0.036
	[0.140]	[0.137]	[0.258]	[0.266]	[0.124]	[0.124]
Imports/Output	-0.021	-0.019	0.004	0.009	-0.027	-0.029
	[0.024]	[0.024]	[0.035]	[0.035]	[0.021]	[0.021]
Private Credit	0.008	0.01	-0.003	-0.005		
	[0.029]	[0.029]	[0.042]	[0.044]		
Private Credit*Extern.Fin	0.036**	0.038**	0.096	0.112	0.017	
	[0.017]	[0.017]	[0.062]	[0.076]	[0.015]	
Private Credit*Liq.Needs						0.078
						[0.111]
Country FE	yes	yes	no	no	no	no
Sector FE	yes	no	no	no	no	no
Time FE	yes	no	yes	no	no	no
Country*Sector FE	no	no	yes	yes	no	no
Sector*Time FE	no	yes	no	yes	yes	yes
Country*Time FE	no	no	no	no	yes	yes
Observations	3777	3777	3777	3777	3777	3777
R-squared	0.31	0.33	0.57	0.59	0.41	0.41

Notes: Robust standard errors in brackets; standard errors are clustered at country*time level in columns (1)-(4); * significant at 10%; ** significant at 5%; *** significant at 1%. The sample is a panel of three decades, 1970-79, 1980-89 and 1990-99; all of the variables are 10-year averages, unless otherwise indicated. The dependent variable is the growth rate of output. *FINLIB* is gross capital flows, defined as the absolute value of total inflows plus the absolute value of total outflows as a share of GDP. *Log(Initial Output/Worker)* is the log of beginning-of-period output per worker in a sector. *Initial Share* is the beginning-of-period share of output in a sector in total manufacturing output. *Exports/Output* and *Imports/Output* are the exports and the imports in the sector divided by the total output in the sector. *Private Credit* is the private credit by banks and other financial institutions as a share of GDP. *Extern.Fin.* is the sector-level measure of reliance on external finance. *Liq. Needs* is the sector-level measure of liquidity needs. All specifications are estimated using OLS, and including the fixed effects specified in the table. Variable definitions and sources are described in detail in the text.

Table 2: De Facto Financial Liberalization and Volatility, 10-year Panel Estimates

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.: Standard Deviation of the Growth Rate of Output						
FINLIB	0.266**	0.271**	0.269*	0.277*		
	[0.108]	[0.109]	[0.147]	[0.149]		
Extern.Fin*FINLIB					0.164**	
					[0.081]	
Liq.Needs*FINLIB						1.836***
						[0.598]
Log(Output/Worker)	-0.021***	-0.021***	-0.021	-0.023	-0.020***	-0.020***
	[0.005]	[0.005]	[0.013]	[0.014]	[0.005]	[0.005]
Initial Share	-0.283***	-0.282***	-0.289*	-0.335**	-0.288***	-0.280***
	[0.041]	[0.042]	[0.147]	[0.166]	[0.042]	[0.042]
Exports/Output	0.005	-0.018	-0.145	-0.211	-0.043	-0.039
	[0.124]	[0.120]	[0.210]	[0.211]	[0.128]	[0.129]
Imports/Output	-0.005	0.000	0.005	0.016	0.000	-0.001
	[0.025]	[0.024]	[0.031]	[0.031]	[0.025]	[0.025]
Private Credit	0.007	0.014	-0.067	0.011		
	[0.048]	[0.047]	[0.080]	[0.093]		
Private Credit*Liq.Needs	-0.08	-0.128	0.38	-0.1		-0.330**
	[0.160]	[0.155]	[0.410]	[0.525]		[0.148]
Private Credit*Extern.Fin					-0.006	
					[0.020]	
Country FE	yes	yes	no	no	no	no
Sector FE	yes	no	no	no	no	no
Time FE	yes	no	yes	no	no	no
Country*Sector FE	no	no	yes	yes	no	no
Sector*Time FE	no	yes	no	yes	yes	yes
Country*Time FE	no	no	no	no	yes	yes
Observations	3761	3761	3761	3761	3761	3761
R-squared	0.39	0.41	0.65	0.66	0.48	0.48

Notes: Robust standard errors in brackets; standard errors are clustered at country-time level in columns (1)-(4); * significant at 10%; ** significant at 5%; *** significant at 1%. The sample is a panel of three decades, 1970-79, 1980-89 and 1990-99; all of the variables are 10-year averages unless otherwise indicated. The dependent variable is the standard deviation of the growth rate of output over the 10-year period. *FINLIB* is gross capital flows, defined as the absolute value of total inflows plus the absolute value of total outflows. *Log(Initial Output/Worker)* is the log of output per worker in a sector. *Initial Share* is the beginning-of-period share of output in a sector in total manufacturing output. *Exports/Output* and *Imports/Output* are the exports and the imports in the sector divided by the total output in the sector. *Private Credit* is the private credit by banks and other financial institutions as a share of GDP. *Extern.Fin.* is the sector-level measure of reliance on external finance. *Liq. Needs* is the sector-level measure of liquidity needs. All specifications are estimated using OLS, and including the fixed effects specified in the table. Variable definitions and sources are described in detail in the text.

Table 3: Difference-in-Differences Results Based on Control Countries

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var.: Growth Rate of Output								
Treated	0.015*	0.015	0.015**	0.016*	0.034***	0.035***	0.025***	0.035***
	[0.008]	[0.013]	[0.006]	[0.009]	[0.008]	[0.013]	[0.006]	[0.010]
Post	-0.012***	-0.011*	-0.003	-0.013***	-0.021***	-0.021*	-0.007*	-0.021**
	[0.004]	[0.006]	[0.002]	[0.004]	[0.007]	[0.011]	[0.004]	[0.009]
Exports/Output	-0.004	-0.013**	-0.004	-0.004	0.003	-0.004	0.003	0.004
	[0.004]	[0.006]	[0.004]	[0.003]	[0.005]	[0.013]	[0.005]	[0.006]
Imports/Output	0	-0.001	0	0	-0.004*	-0.003	-0.005**	-0.005*
	[0.000]	[0.002]	[0.001]	[0.001]	[0.002]	[0.003]	[0.002]	[0.003]
Initial Share	-0.053***	-1.553***	-0.054***	-0.218***	-0.036	-1.598***	-0.038	-0.191***
	[0.019]	[0.146]	[0.019]	[0.041]	[0.030]	[0.205]	[0.030]	[0.072]
Private Credit	0.026	-0.006	-0.028*	0.039*	-0.051	-0.091	0.011	-0.055
	[0.018]	[0.029]	[0.017]	[0.020]	[0.039]	[0.058]	[0.034]	[0.049]
Private Credit*Extern.Fin	0.053***	0.176***	0.052***	0.007	0.059***	0.182***	0.059***	0.053**
	[0.005]	[0.016]	[0.005]	[0.016]	[0.007]	[0.027]	[0.007]	[0.026]
Country FE	yes	no	yes	yes	yes	no	yes	yes
Country*Sector FE	no	yes	no	no	no	yes	no	no
Group*Time FE	no	no	yes	no	no	no	yes	no
Group*Sector FE	no	no	no	yes	no	no	no	yes
Control Group	ALL	ALL	ALL	ALL	PSM	PSM	PSM	PSM
Observations	3799	3799	3799	3799	1738	1738	1738	1738
R-squared	0.35	0.75	0.39	0.5	0.43	0.79	0.47	0.63

Notes: Robust standard errors clustered at country*time level in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%. The dependent variable is the average growth rate of output during the 10 years immediately before or immediately after an episode of financial liberalization. *Treated* takes on the value of 1 if a liberalization event took place in a country, and zero otherwise. *Post* takes on the value of zero before the liberalization event, and 1 after, for all countries irrespective of whether they liberalized. *Initial Share* is the beginning-of-period share of output in a sector in total manufacturing output. *Exports/Output* and *Imports/Output* are the exports and the imports in the sector divided by the total output in the sector. *Private Credit* is the private credit by banks and other financial institutions as a share of GDP. *Extern.Fin.* is the sector-level measure of reliance on external finance. In the first 4 columns the control group consists of all countries (within the group of OECD/non-OECD) which did not liberalize within the 20-year period. In the last four columns the control group is the country selected by the propensity score matching procedure (PSM). All specifications are estimated using OLS, and including the fixed effects specified in the table. Variable definitions and sources are described in detail in the text.

Table 4: Difference-in-Differences Results Based on Control Countries, Volatility

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var.: Standard Deviation of the Growth Rate of Output								
Treated	0.022**	0.021	0.015**	0.022**	0.022**	0.022	0.025***	0.023*
	[0.009]	[0.014]	[0.006]	[0.009]	[0.011]	[0.017]	[0.006]	[0.013]
Post	-0.002	-0.001	0.013	-0.001	-0.005	-0.004	0.020***	-0.003
	[0.007]	[0.011]	[0.013]	[0.007]	[0.017]	[0.026]	[0.006]	[0.020]
Exports/Output	0.030***	0.016	0.030***	0.016***	0.025***	0.015	0.024***	0.009
	[0.005]	[0.015]	[0.005]	[0.005]	[0.007]	[0.013]	[0.007]	[0.008]
Imports/Output	0.003	0.000	0.002	0.001	0.003	0.002	0.003	0.002
	[0.002]	[0.002]	[0.002]	[0.001]	[0.002]	[0.002]	[0.002]	[0.002]
Initial Share	-0.281***	-0.888***	-0.282***	-0.250***	-0.236***	-0.446	-0.237***	-0.103
	[0.026]	[0.216]	[0.026]	[0.059]	[0.047]	[0.403]	[0.047]	[0.094]
Private Credit	-0.016	-0.124**	-0.073**	-0.069*	0	-0.026	-0.019	-0.017
	[0.037]	[0.062]	[0.037]	[0.041]	[0.093]	[0.169]	[0.060]	[0.120]
Private Credit*Liq.Needs	-0.089	0.617	-0.088	0.258*	-0.075	0.097	-0.069	0.029
	[0.057]	[0.397]	[0.057]	[0.131]	[0.072]	[0.595]	[0.072]	[0.250]
Country FE	yes	no	yes	yes	yes	no	yes	yes
Country*Sector FE	no	yes	no	no	no	yes	no	no
Group*Time FE	no	no	yes	no	no	no	yes	no
Group*Sector FE	no	no	no	yes	no	no	no	yes
Control Group	ALL	ALL	ALL	ALL	PSM	PSM	PSM	PSM
Observations	3789	3789	3789	3789	1737	1737	1737	1737
R-squared	0.28	0.71	0.29	0.48	0.3	0.72	0.33	0.57

Notes: Robust standard errors clustered at country*time level in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%. The dependent variable is the standard deviation of the growth rate of output during the 10 years immediately before or immediately after an episode of financial liberalization. *Treated* takes on the value of 1 if a liberalization event took place in a country, and zero otherwise. *Post* takes on the value of zero before the liberalization event, and 1 after, for all countries irrespective of whether they liberalized. *Initial Share* is the beginning-of-period share of output in a sector in total manufacturing output. *Exports/Output* and *Imports/Output* are the exports and the imports in the sector divided by the total output in the sector. *Private Credit* is the private credit by banks and other financial institutions as a share of GDP. *Liq. Needs* is the sector-level measure of liquidity needs. In the first 4 columns the control group consists of all countries (within the group of OECD/non-OECD) which did not liberalize within the 20-year period. In the last four columns the control group is the country selected by the propensity score matching procedure (PSM). All specifications are estimated using OLS, and including the fixed effects specified in the table. Variable definitions and sources are described in detail in the text.

Table 5: De Facto Financial Liberalization and Growth, 10-year Panel Estimates, Channels

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Number of Establishments		Employment		Capital Accumulation		Total Factor Productivity	
FINLIB	0.217*		0.234**		0.229***		0.035	
	[0.128]		[0.095]		[0.074]		[0.060]	
Extern.Fin*FINLIB		0.113*		0.188***		0.136**		0.004
		[0.061]		[0.050]		[0.054]		[0.049]
Log(Initial Output/Worker)	0.014	0.006	0.008	0.007**	0.000	0.006*	-0.029***	-0.019***
	[0.017]	[0.004]	[0.009]	[0.004]	[0.007]	[0.003]	[0.010]	[0.004]
Initial Share	-0.465**	-0.014	-0.803***	-0.088***	-0.083	-0.013	-0.284***	0.009
	[0.198]	[0.029]	[0.105]	[0.024]	[0.085]	[0.026]	[0.088]	[0.027]
Exports/Output	0.858**	-0.006	-0.182	-0.021	-0.071	0.065	-0.127	-0.09
	[0.425]	[0.154]	[0.220]	[0.112]	[0.092]	[0.071]	[0.254]	[0.122]
Imports/Output	-0.039	0.058*	0.048	0.031	0.01	-0.001	0.001	-0.017
	[0.027]	[0.035]	[0.030]	[0.027]	[0.023]	[0.009]	[0.035]	[0.019]
Private Credit	0.018		-0.008		0.064*		-0.027	
	[0.164]		[0.039]		[0.035]		[0.028]	
Private Credit*Extern.Fin	-0.022	0.015	0.084*	0.020*	0.022	0.033***	0.038	-0.008
	[0.087]	[0.015]	[0.046]	[0.012]	[0.032]	[0.011]	[0.053]	[0.014]
Country*Sector FE	yes	no	yes	no	yes	no	yes	no
Sector*Time FE	yes	yes	yes	yes	yes	yes	yes	yes
Country*Time FE	no	yes	no	yes	no	yes	no	yes
Observations	2254	2254	3779	3779	3032	3032	3027	3027
R-squared	0.64	0.40	0.60	0.44	0.66	0.50	0.54	0.25

Notes: Robust standard errors in brackets; standard errors are clustered at country*time level in columns (1), (3), and (5); * significant at 10%; ** significant at 5%; *** significant at 1%. The sample is a panel of three decades, 1970-79, 1980-89 and 1990-99; all of the variables are 10-year averages unless otherwise indicated. The dependent variable is the growth rate of the number of establishments, total employment, capital stock, or TFP, in a sector. *FINLIB* is gross capital flows, defined as the absolute value of total inflows plus the absolute value of total outflows. *Log(Initial Output/Worker)* is the log of beginning-of-period output per worker in a sector. *Initial Share* is the beginning-of-period share of output in a sector in total manufacturing output. *Exports/Output* and *Imports/Output* are the exports and the imports in the sector divided by the total output in the sector. *Private Credit* is the private credit by banks and other financial institutions as a share of GDP. *Extern.Fin.* is the sector-level measure of reliance on external finance. All specifications are estimated using OLS, and including the fixed effects specified in the table. Variable definitions and sources are described in detail in the text.

Table 6: Difference-in-Differences Results Based on Control Countries, Channels

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Number of Establishments		Employment		Capital accumulation		Total factor productivity	
Treated	0.006	0.028***	0.011**	0.023***	0.018*	0.040***	0.010*	0.000
	[0.009]	[0.007]	[0.005]	[0.005]	[0.011]	[0.011]	[0.006]	[0.006]
Post	-0.084***	-0.018***	-0.054***	-0.050***	0.023**	-0.061***	-0.008	0.002
	[0.027]	[0.007]	[0.007]	[0.006]	[0.011]	[0.009]	[0.006]	[0.008]
Exports/Output	-0.003	0.011*	0.007*	0.004	0.003	-0.002	-0.003	0.000
	[0.003]	[0.006]	[0.004]	[0.004]	[0.003]	[0.005]	[0.003]	[0.003]
Imports/Output	0.000	-0.003**	-0.001***	-0.003	0.000	0.002	0.000	-0.005***
	[0.000]	[0.001]	[0.000]	[0.002]	[0.000]	[0.002]	[0.000]	[0.001]
Initial Share	-0.023	-0.044	-0.049***	-0.031	0.048***	0.049***	-0.056***	-0.060**
	[0.014]	[0.026]	[0.018]	[0.019]	[0.014]	[0.018]	[0.013]	[0.023]
Private Credit	0.124	0.092	-0.019	-0.018	0.033	0.057	-0.068***	-0.065
	[0.078]	[0.056]	[0.015]	[0.033]	[0.027]	[0.068]	[0.017]	[0.039]
Private Credit*Extern.Fin	0.045***	0.049***	0.048***	0.055***	0.048***	0.060***	0.007***	0.002
	[0.005]	[0.006]	[0.004]	[0.005]	[0.004]	[0.005]	[0.002]	[0.003]
Country FE	yes	yes	yes	yes	yes	yes	yes	yes
Group*Time FE	yes	yes	yes	yes	yes	yes	yes	yes
Control Group	ALL	PSM	ALL	PSM	ALL	PSM	ALL	PSM
Observations	2870	1510	3839	1764	3287	1539	3267	1536
R-squared	0.42	0.47	0.4	0.48	0.58	0.65	0.24	0.2

Notes: Robust standard errors clustered at country*time level in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%. The dependent variable is the average growth rate of the number of establishments, total employment, capital stock, and TFP during the 10 years immediately before or immediately after an episode of financial liberalization. *Treated* takes on the value of 1 if a liberalization event took place in a country, and zero otherwise. *Post* takes on the value of zero before the liberalization event, and 1 after, for all countries irrespective of whether they liberalized. *Initial Share* is the beginning-of-period share of output in a sector in total manufacturing output. *Exports/Output* and *Imports/Output* are the exports and the imports in the sector divided by the total output in the sector. *Private Credit* is the private credit by banks and other financial institutions as a share of GDP. *Extern.Fin.* is the sector-level measure of reliance on external finance. In columns (1), (3) and (5) the control group consists of all countries (within the group of OECD/non-OECD) which did not liberalize within the 20-year period. In columns (2), (4), and (6) the control group is the country selected by the propensity score matching procedure (PSM). All specifications are estimated using OLS, and including the fixed effects specified in the table. Variable definitions and sources are described in detail in the text.

Table 7: The Welfare Gains of Financial Liberalization

	Persistence of Consumption Shocks					
	ρ=0			ρ=0.7		
	Risk Aversion			Risk Aversion		
	γ=1	γ=2.5	γ=5	γ=1	γ=2.5	γ=5
Volatility Effects						
	Panel A: Growth and Volatility Effects (Perfect Domestic Risk-Sharing)					
Temporary	0.2	0.172	0.129	0.199	0.169	0.129
Permanent	0.2	0.171	0.128	0.198	0.168	0.128
	Panel B: Growth and Volatility Effects (No Domestic Risk-Sharing)					
Temporary	0.199	0.165	0.108	0.194	0.152	0.086
Permanent	0.197	0.163	0.107	0.19	0.146	0.082

Notes: The welfare gains are measured as the compensating variation in consumption that an agent must receive in order to remain indifferent between an initial consumption process (characterized by its growth and volatility) and the one resulting from financial liberalization. The initial process for consumption corresponds to an economy which is not financially liberalized. The parameter γ is the coefficient of relative risk aversion. The discount rate is set at β=0.95, while ρ represents the AR(1) coefficient of persistence in the consumption process. See Section 5 for the underlying model and methodology used in the calculations.

Appendix Table A1: Country Sample and Summary Statistics

Country	Total Manufacturing Output		Gross Capital	Country	Total Manufacturing Output		Gross Capital
	Growth	St. Dev.	Flows		Growth	St. Dev.	Flows
Australia	0.017	0.033	0.065	Korea, Rep.	0.105	0.075	0.068
Austria	0.020	0.048	0.123	Malawi	0.057	0.117	0.080
Bangladesh	0.072	0.211	0.033	Malaysia	0.122	0.078	0.092
Canada	0.035	0.062	0.099	Malta	0.044	0.088	0.514
Chile	0.051	0.122	0.107	Mauritius	0.051	0.062	0.048
Colombia	0.037	0.044	0.044	Mexico	0.042	0.114	0.046
Costa Rica	0.011	0.080	0.055	Netherlands	0.014	0.084	0.162
Cyprus	0.079	0.097	0.112	New Zealand	0.017	0.049	0.050
Denmark	0.006	0.032	0.099	Norway	0.025	0.057	0.101
Ecuador	0.066	0.107	0.079	Pakistan	0.078	0.054	0.041
Egypt, Arab Rep.	0.045	0.071	0.069	Peru	-0.017	0.105	0.069
Fiji	0.040	0.103	0.068	Philippines	0.055	0.087	0.082
Finland	0.029	0.068	0.102	Poland	0.013	0.119	0.071
France	0.022	0.054	0.105	Portugal	0.054	0.089	0.110
Germany	0.020	0.048	0.082	Senegal	0.032	0.143	0.072
Greece	0.013	0.048	0.041	Singapore	0.110	0.119	0.326
Guatemala	0.044	0.120	0.049	South Africa	-0.004	0.076	0.051
Honduras	0.056	0.058	0.067	Spain	0.032	0.073	0.076
Hungary	-0.011	0.080	0.078	Sri Lanka	0.086	0.182	0.061
Iceland	0.031	0.059	0.051	Sweden	0.017	0.068	0.111
India	0.069	0.065	0.017	Syrian Arab Republic	0.104	0.201	0.043
Indonesia	0.114	0.066	0.054	Tanzania	-0.015	0.109	0.033
Ireland	0.052	0.065	0.149	Trinidad and Tobago	0.050	0.137	0.067
Israel	0.048	0.121	0.122	Turkey	0.068	0.074	0.030
Italy	0.040	0.089	0.084	United Kingdom	0.020	0.083	0.114
Jamaica	0.029	0.076	0.062	United States	0.024	0.052	0.053
Japan	0.018	0.057	0.047	Uruguay	0.014	0.124	0.080
Jordan	0.116	0.154	0.113	Zimbabwe	0.064	0.098	0.033
				Mean	0.043	0.088	0.087
				Standard Deviation	0.033	0.039	0.074

Notes: The first two columns report the average growth rate and the standard deviation of the growth rate of total manufacturing output (source: UNIDO database, 2006). The last column reports the average gross capital flows -- absolute value of inflows plus the absolute value of outflows as a share of GDP (source: IMF Balance of Payments Statistics) -- which is used in this paper as a de facto measure of financial integration.

Appendix Table A2: Liberalization Episodes

Liberalizing Country	Liberalization year	Control Country
Canada	1976	Denmark
United Kingdom	1981	Spain
Germany	1982	Japan
United States	1982	Japan
Denmark	1989	Canada
Norway	1989	Canada
Sweden	1989	Chile
Finland	1990	Canada
France	1990	Canada
Indonesia	1990	Korea, Rep.
Ireland	1992	Korea, Rep.
Italy	1992	Germany
Japan	1992	Germany
Mexico	1992	Korea, Rep.
Peru	1992	Korea, Rep.
Portugal	1993	Korea, Rep.
Spain	1993	Germany
Chile	1999	Malaysia
Taiwan Province of China	1999	Malaysia

Notes: This table reports the countries and years of liberalization episodes, defines as the year in which the Kaminsky and Schmukler (2007) index starts taking on the value of 3. The last column reports the control country identified in the propensity score matching procedure, and used in the regressions specifications marked "PSM."

Appendix Table A3: The Correlation Matrix of the Independent Variables

	FINLIB	Log(Initial Output/ Worker)	Initial Share	Exports/ Output	Imports/ Output	Private Credit
FINLIB	*0.059*					
Log(Initial Output/Worker)	0.089	*0.885*				
Initial Share	0.004	-0.099	*0.054*			
Exports/Output	0.036	-0.086	-0.026	*0.020*		
Imports/Output	0.001	-0.101	-0.060	0.636	*0.136*	
Private Credit	0.451	0.266	-0.010	-0.009	-0.042	*0.235*

Notes: This table presents the correlation matrix for the independent variables. The off-diagonal elements are correlations. The diagonal elements, in italics, are standard deviations of the variable.

Supplementary Web Appendix to
"Growth and Risk at the Industry Level:
the Real Effects of Financial Liberalization"

Andrei A. Levchenko, Romain Rancière, and Mathias Thoenig

A Propensity Score Matching

In order to overcome the selection on observables problem in the difference-in-differences model (3), we implement a propensity score matching procedure (hereafter PSM) to identify a control country for each treated one.

The basic idea of propensity score matching is to simulate a randomized experiment. We want to pair together countries with similar characteristics. To do so, we use a vector of covariates X, and assume that conditional on the vector X, the expected value of the variable of interest (in our case, output growth or output volatility) in the absence of financial liberalization would be the same for the treated and the control countries that have been paired together. If this assumption holds, it is legitimate to see the control country as an identical twin of the treated country if the latter *had not received treatment*. Thus, the difference between the treated and control countries will be an appropriate estimate of the effect of financial liberalization – the treatment effect.

The relevant set of covariates, X, should include variables that are co-determinants of the financial liberalization treatment and of the outcome variables of interest. Since the treatment happens at the country-level, we consider a set country-level variables for X. An obvious difficulty in performing a matching based on X is the multi-dimensionality of the information set. As shown by Rosenbaum and Rubin (1983), it is possible to match instead on the probability of liberalization conditional on the vector X, which is a scalar quantity. We therefore define the *propensity score* as the conditional probability of receiving the liberalization treatment for country c in year t given X:

$$p_{ct}(X) = Pr(z_{ct} = 1|X),$$

where $z_{ct} = 1$ if country c is fully liberalized at time t and $z_{ct} = 0$ otherwise. The basic econometric results supporting the PSM approach are derived in Rosenbaum and Rubin (1983). In particular, Theorem 1 in Rosenbaum and Rubin (1983) states that, under some conditions, exposure to the treatment and the observed covariates are conditionally inde-

pendent given the propensity score ($z \perp X|p(X)$). [28]

The propensity matching procedure follows three steps. In the first step, we use a logit model to estimate the probabilities of financial liberalization, that we call the propensity scores, for a sample of countries and years. Next, following Dehejia and Wahba (2002), we group observations into intervals with similar propensity score – referred to as propensity score strata – and test whether the means of each right-hand side variable do not differ between treated and non-treated units within each stratum.[29] In the third step, we construct the relevant control group for each treated country using a proximity measure based on propensity scores.

In our case, the first step involves estimating the following logit model:

$$E(TREATED_{ct}|X_i) = \frac{\exp(AX_{ct})}{1 - \exp(AX_{ct})},$$

where $TREATED_{ct}$ is the indicator for whether or not the country is liberalized and X_{ct} a vector of covariates. In the baseline specification X_{ct} includes the log of PPP-adjusted per capita income ($INCOME_{ct}$), the volatility of the per capita GDP growth over the previous 5 years ($VOLATILITY_{ct}$), the trade openness ($OPEN_{ct}$), defined as imports plus exports as a share of GDP, life expectancy ($LIFE\_EXP_{ct}$), the number of years the current government has been in office (YRS_OFFC_{ct}) and an index of voice and accountability ($VOICE_c$).[30]

The logit specification borrows from a small literature on the determinants of financial liberalization and, in particular, from Abiad and Mody (2005). It includes economic, political, and institutional variables. Note that the objective of the logit estimation is not to predict financial liberalization but to obtain a distribution of propensity scores that allows to match treated and control countries. For this reason, we favor a parsimonious specification that includes variables that are significant determinants of financial liberalization and, at the same time, passes the Dehejia and Wahba (2002) test of equality of means within strata referred to above. In the final specification, more than 85 percent of tests fail to reject equality of means within strata. We also experimented with a wide variety of other

[28] PSM methods were first used in international economics by Persson (2001) and Glick, Guo and Hutchinson (2006).

[29] This is a test of the *balancing hypothesis* which needs to be verified for the Rosenbaum and Rubin (1983) theorem to be valid.

[30] The first three variables come from the Penn World Tables. Life expectancy comes from the U.N. Population Database. The sources for YRS_OFFC_{ct} and $VOICE_c$ are the World Bank's Database of Political Institutions (Beck et al., 2001) and the Governance Matters Database of Kaufmann, Kraay, and Mastruzzi (2005), respectively.

country variables, capturing the level of development, human capital, various aspects of institutions, the incidence of financial and currency crises, and the composition of trade and output. In addition, we included measures of global growth opportunities developed by Bekaert, Harvey, Lundblad, and Siegel (2006) to control for the possible simultaneity between the decision to financially liberalize and a change in the country's growth potential. Many of these variables turned out to be insignificant.

The results of the logit estimation are reported in Appendix Table A4. Having estimated this logit model, the last step consists of exploiting the propensity scores to construct control groups. For each liberalization episode, we calculate the probability of liberalization during the five years immediately preceding the actual liberalization. We then compare these probabilities to those of all the other potential control countries, defined as all the countries that did not liberalize during the 20-year window around the episode in question. Letting C be the set of all countries, we define the *proximity* between the liberalized country $c \in C$ and another country d as the average of the square of the difference between p_{dt} and p_{ct} for the five-year period prior to financial liberalization:

$$proximity_{dc} = \frac{1}{5} \sum_{t=t_c-4}^{t_c} (p_{dt} - p_{ct})^2 , \tag{A.1}$$

where t_c is the year country c liberalized.[31] We use the *first neighbor* matching method and define the control group of the liberalized country c as:

$$CG_c = \underset{\substack{d \in C \\ |t_c - t_d| \geq 10}}{\text{argmin}} \{proximity_{dc}\} ,$$

where the additional restriction of a 10 years' difference between liberalization dates of c and d is required to prevent countries that liberalized around the same time as c from being included in its control group. The list of control countries for each liberalization episode is presented in Appendix Table A2. In addition to the tests of equality of means within each stratum, we perform the following check suggested by Glick, Guo and Hutchinson (2006): a two-sample test of equality of means between the sample of treated and control countries for each independent variable measured at the time of financial liberalization. In all cases but one, the variables in our specification satisfy this test. Once the control group has been constructed, it is used in the estimation of equation (3) described in Section 3.2.

[31] Missing data may lead to missing years in the p_{ct} set. When this happens, we adapt the equation (A.1) to be an average over the propensity scores available.

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Appendix Table A4: PSM Logit Regression

	(1)
Dep. Var.: TREATED	
Log(Per capita income)	3.829***
	[0.642]
Growth volatility over past 5 years	46.590***
	[12.425]
Trade/GDP	-0.026***
	[0.005]
Current government's years in office	0.248***
	[0.037]
Voice and accountability	-0.054
	[0.427]
Log(Life expectancy)	63.586***
	[7.470]
Constant	-308.625***
	[33.063]
Observations	575
Estimation Technique	Logit

Notes: Robust standard errors in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%. *TREATED* takes on the value of 1 when the country is liberalized, zero otherwise. *Log(Per capita income)* is the log of PPP-adjusted per capita income from Penn World Tables. *Trade/GDP* is exports plus imports as a share of GDP; *Log(Life Expectancy)* is the log of the life expectancy; *Current government's years in office* is how many years the active government has been in office; *Voice and accountability* is an index sources from the World Bank's Governance Matters Database; *Growth Volatility* is the volatility of the GDP growth rate over the preceding 5 years. Variable definitions and sources are described in detail in the text.

Appendix Table A5: Measures of External Dependence and Liquidity Needs

ISIC code	Industrial sector	External dependence	Liquidity needs
311	Food products	0.14	0.11
313	Beverages	0.08	0.09
314	Tobacco	-0.45	0.24
321	Textile	0.19	0.16
322	Apparel	0.03	0.20
323	Leather	-0.14	0.27
324	Footwear	-0.08	0.22
331	Wood products	0.28	0.13
332	Furniture	0.24	0.16
341	Paper and products	0.17	0.11
342	Printing and publishing	0.2	0.08
351	Industrial chemicals	0.25	0.13
352	Other chemicals	0.75	0.15
353	Petroleum refineries	0.04	0.06
354	Petroleum and coal products	0.33	0.15
355	Rubber products	0.23	0.14
356	Plastic products	1.14	0.14
361	Pottery	-0.15	0.17
362	Glass	0.53	0.16
369	Nonmetal products	0.06	0.15
371	Iron and steel	0.09	0.16
372	Nonferrous metal	0.01	0.15
381	Metal products	0.24	0.18
382	Machinery	0.6	0.21
383	Electric machinery	0.95	0.21
384	Transportation equipment	0.36	0.15
385	Professional goods	0.96	0.22
390	Other industries	0.47	0.21

Source: Klingebiel, Kroszner, and Laeven (2007) and Raddatz (2006). External dependence is defined as capital expenditure minus cash flow, divided by capital expenditure. Liquidity needs are defined as inventories/sales. Both measures are constructed based on US firm-level data.

Appendix Table A6: Financial Liberalization, Growth, and Volatility Using De Jure Indices, 10-year Panel Estimates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dep. Var.: Growth Rate of Output				**Dep. Var.: Volatility of the Growth Rate of Output**			
KS Index	0.015**	0.015*	0.017*	0.017*	0.031***	0.031***	0.027**	0.027**
	[0.007]	[0.007]	[0.009]	[0.009]	[0.011]	[0.011]	[0.013]	[0.013]
Log(Initial Output/Worker)	-0.018**	-0.013	-0.046***	-0.040**	-0.017**	-0.015**	-0.006	-0.005
	[0.008]	[0.008]	[0.014]	[0.015]	[0.007]	[0.007]	[0.014]	[0.017]
Initial Share	-0.204***	-0.211***	-0.724***	-0.971***	-0.05	-0.02	-0.207***	-0.071
	[0.065]	[0.068]	[0.147]	[0.179]	[0.050]	[0.046]	[0.076]	[0.097]
Exports/Output	0.231**	0.225**	0.142	0.133	-0.016	-0.217	0.938**	0.08
	[0.092]	[0.104]	[0.148]	[0.170]	[0.224]	[0.199]	[0.409]	[0.591]
Imports/Output	-0.278**	-0.238*	-0.073	-0.013	-0.254***	-0.265***	-0.212	-0.367
	[0.125]	[0.128]	[0.159]	[0.175]	[0.068]	[0.065]	[0.241]	[0.278]
Private Credit	-0.008	-0.009	-0.004	-0.011	0.157	0.06	0.076	-0.054
	[0.048]	[0.048]	[0.055]	[0.057]	[0.299]	[0.292]	[0.228]	[0.215]
Private Credit*Extern.Fin	0.018	0.022	0.084**	0.105**	0.27	0.262	0.485	0.527*
	[0.022]	[0.022]	[0.039]	[0.047]	[0.294]	[0.271]	[0.304]	[0.314]
Country FE	yes	yes	no	no	yes	yes	no	no
Sector FE	yes	no	no	no	yes	no	no	no
Time FE	yes	no	yes	no	yes	no	yes	no
Country*Sector FE	no	no	yes	yes	no	no	yes	yes
Sector*Time FE	no	yes	no	yes	no	yes	no	yes
Country*Time FE	no	no	no	no	no	no	no	no
Observations	1692	1692	1692	1692	1691	1691	1691	1691
R-squared	0.39	0.43	0.64	0.68	0.45	0.48	0.67	0.69

Notes: Standard errors clustered at country-time level in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%. The sample is a panel of three decades, 1970-79, 1980-89 and 1990-99; all of the variables are 10-year averages unless otherwise indicated. The dependent variable is the growth rate of output in columns (1)-(3), and the volatility of the growth rate of output in columns (4)-(6). *KS Index* is the initial value of the Kaminsky-Schmukler index of financial liberalization. *Log(Output/Worker)* is the log of output per worker in a sector. *Initial Share* is the beginning-of-period share of output in a sector in total manufacturing output. *Exports/Output* and *Imports/Output* are the exports and the imports in the sector divided by the total output in the sector. *Private Credit* is the private credit by banks and other financial institutions as a share of GDP. *Extern.Fin.* is the sector-level measure of reliance on external finance. All specifications are estimated using OLS, and including the fixed effects specified in the table.

Appendix Table A7: Difference-in-Differences Results Based on Industry Characteristics

	(1)	(2)	(3)	(4)
	Output			
	Growth		Volatility	
Extern.Fin*treated	0.016*		0.024*	
	[0.010]		[0.015]	
Liq.Needs*treated		0.100		0.158*
		[0.067]		[0.097]
Exports/Output	0.004	0.005	0.007	0.008
	[0.005]	[0.005]	[0.011]	[0.011]
Imports/Output	-0.004**	-0.004**	-0.001	-0.001
	[0.002]	[0.002]	[0.001]	[0.001]
Initial Share	-0.109*	-0.113*	-0.332***	-0.329***
	[0.066]	[0.064]	[0.105]	[0.103]
Private Credit*Extern.Fin	0.005		0.031	
	[0.020]		[0.029]	
Private Credit*Liq. Needs		0.237		0.316
		[0.152]		[0.202]
Country*Time FE	yes	yes	yes	yes
Sector FE	yes	yes	yes	yes
Observations	852	852	851	851
R-squared	0.55	0.55	0.46	0.46

Notes: Robust standard errors in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%. The dependent variable is the average growth rate, or the standard deviation of the growth rate of output during the 10 years immediately before or immediately after an episode of financial liberalization. *Treated* takes on the value of 1 if a liberalization event took place, and zero otherwise. *Private Credit* is the private credit by banks and other financial institutions as a share of GDP. *Extern.Fin.* is the sector-level measure of reliance on external finance. *Liq. Needs* is the sector-level measure of liquidity needs. *Initial Share* is the beginning-of-period share of output in a sector in total manufacturing output. *Exports/Output* and *Imports/Output* are the exports and the imports in the sector divided by the total output in the sector. All specifications are estimated using OLS, and including country*time and sector fixed effects. Variable definitions and sources are described in detail in the text.