March 2009, Draft.

Paradoxes of Productivity: Trade liberalisation and Morocco

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Abstract

Theory and much empirical evidence suggest that increased openness should lead to increases in productivity. Those increases in productivity occur on both the export and import side and are driven by technology transfer and increases in competition resulting in the exit of inefficient firms and sectors, the growth of firm-level productivity, and the increasing share of more productive firms in the market. Morocco in the 1990's saw a period of substantial trade policy reform and other domestic reforms, aimed at increasing rates of economic growth. However, the evidence in this paper indicates that productivity growth over 1990-2002 for key manufacturing sectors has been minimal. With regard to firm-level changes in productivity, we control for possible endogeneity bias on both the export and import side, and show that that increased exports leads only very slightly to higher levels of productivity; and there is only weak evidence that domestic liberalisation increased productivity. Contrary to much of the existing literature, our results also show that, when taking into account firm-level heterogeneity, tariffs tend to increase the TFP of those firms who are further away from the productivity frontier. The low levels of firm-level productivity change are corroborated by our decomposition analysis where we also consider market share changes as well as the role of entry and exit. Once again, and contrary to much of the theoretical and empirical Melitz inspired literature, we find that firms whose productivity was below average tend to increase their share of output, those whose productivity was above average decrease their share. There is also evidence of considerable entry and exit in aggregate lowering productivity as entering firms typically have lower levels of productivity. Hence while the mechanisms driving trade and productivity linkages, and 'creative destruction' are well documented, these results reinforce the need to understand more fully the circumstances under which they may or may not arise.

JEL Classification numbers: F2 O1 O2
Keywords: Productivity, Trade liberalisation, Firm heterogeneity.

Our thanks go to Stefania Lovo for superb research assistance, to Marion Dovis for giving us access to her programs for the direct estimation procedure, and to Charles Lai-tong and Barry Reilly for advice on the econometrics. Any errors or omissions remain our responsibility.

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1. Introduction

In this paper we explore the impact of trade liberalisation in Morocco on manufacturing sector productivity. We examine the impact with regard to both imports and exports and, in contrast to much of the existing literature, our results present a somewhat pessimistic and paradoxical picture.

In Morocco the process of trade liberalisation has not led to any significant increases in productivity, and indeed with some of the evidence suggesting the reverse. While we find evidence that improvements in the productivity frontier increase the productivity levels of those below the frontier, the distance between them widens and hence there is divergence over time. Moreover, in contrast also to the work of Aghion et.al (2005, 2009) we find consistent evidence that trade liberalisation has a bigger positive effect on firm level productivity the *greater* the distance of the firm from the productivity frontier. From both an analytical and policy perspective these are important result. As is now well recognised the potential benefits for countries from trade liberalisation do depend on appropriate institutional, regulatory and infrastructure frameworks being in place. In particular for developing countries, the results in this paper suggest, that where this is not the case the process of creative destruction may not occur, and seemingly paradoxical results may arise. This raises important questions as to the underlying causes, which need further investigation. For example, one possible explanation could be related to financial markets and to differential access to credit for incumbent and new firms.

In order to understand these results it is important to consider the channels by which trade is typically seen to impact positively on productivity. Aggregate productivity growth will be driven either by the inter-industry reallocation of resources to more productive sectors, or by within industry compositional shifts as inefficient firms exit, more productive firms enter and/or increase their share of the market, or through existing firms becoming more productive from economies of scale, technical progress or reductions in x-inefficiency. Trade may induce some of these changes through a number of channels. On the import side domestic liberalisation should lead to increased competition resulting in efficiency improvements at the firm level for example arising from increased innovation (Ederington and McCalman, 2008, Aghion et.al, 2005, 2007, 2009), and restructuring as less efficient firms exit and output is reallocated to more productive plants (cf. Melitz, 2003, Helpman, Melitz and Yeaple, 2004, Bernard, Redding & Schott, 2007 and others). Domestic liberalisation should can also lead to increased FDI and technology transfer (Smarzynska 2004, Blalock & Gertler 2008); improved access to intermediates of higher quality and more variety (Ethier,

1982), as well as lowering the price of intermediates, again leading to increases in firm-level productivity. On the export side productivity may increase through increased knowledge transfer, economies of scale from access to foreign markets, greater competition leading to incentives to increase efficiency, as well as improved ability to absorb domestic demand shocks.

There is considerable supporting empirical evidence on the positive impact of domestic liberalisation on productivity (Pavcnik, 2002, Schor, 2004, Fernandes, 2007, Amiti and Konings, 2007, Greenaway & Keller, 2007). The evidence on exports is more mixed with a number of authors (De Loecker, 2007, Baldwin & Gu, 2003, Castellani, 2002, Delgado, Fariñas & Ruano, 2002, Aw, Chung & Roberts, 2000) arguing that the causality runs in the direction of more productive firms exporting, as opposed to vica versa.

These are potentially powerful transmission mechanisms – yet in Morocco the evidence we present suggests that they work poorly. On the export side we control for the issue of reverse causality and show that exporting does lead to higher productivity, but that the impact is small. Typically an increase in exports by ten percentage points leads to an increase in productivity of around 0.5%. On the import side our regression analysis identifies impacts on firm-level productivity and suggests little evidence that domestic liberalisation resulted in significantly increased productivity. On the one had we find that a reduction in tariffs by ten percentage points results in increases in firm-level productivity of the order of 1%; however, we also find that an increase in import-penetration of ten percentage points reduces productivity by slightly more than 3%. We consider reallocation effects via a decomposition analysis of the change in productivity over time. While there is considerable entry and exit of highly heterogeneous firms in Morocco this process and the market shares changes of incumbents firms have not led to higher productivity as might be expected via the Melitz-style channels. Exiting firms are typically more productive than entering firms while both of these categories are less productive than incumbents. While entering firms increase their productivity and market share over time, their productivity remains inferior to the incumbents hence aggregate productivity does not rise.

This paper uses firm-level data derived from the Moroccan Annual Census of production over the period 1990-2002. We use a three-fold methodology in order to explore the relationship between trade and productivity. First, and analogous to the work of Fernandez (2007), we utilise a *direct* approach for estimating the impact of trade variables – on both the export and the import side - on firm level productivity. As is now well known a key issue in the estimation of production functions is the likely simultaneity bias arising from the fact that firms make input choices but with knowledge of their own productivity. Common ways of controlling for this are based on either the Levinsohn & Petrin (2003), Olley & Pakes (1996) methodologies.

There exists a similar issue of possible endogeneity with regard to trade policy – inefficient firms / industries may be more likely to lobby and receive protection. Hence, Fernandez extends the Levinsohn & Petrin methodology by estimating a production function which includes trade policy (on import side only) as a regressor and which controls for the possible endogeneity. In this paper, we utilise an extension of the Olley & Pakes methodology by allowing for trade policy variable on both the export and import side to be included as regressors, and control for simultaneity with regard to each of these.[1]

Secondly, partly as a means of comparison with previous studies, partly for comparison with our direct approach, but in addition because it allows us to explore determinants of changes in productivity in more depth, we also utilise an indirect approach. In the first instance this requires the estimation of a production function (while controlling for input-endogoneity a la Olley and Pakes), where the residuals provide a measure of firm level productivity; and in the second stage we estimate a productivity equation where we explore the role of a number of variables, including trade policy variables, on productivity. Of central interest here is the relationship between firm level productivity,and trade policy with the distance of firms from the TFP frontier.

Thirdly, in order to the extent to which changes in productivity may be driven by reallocation effects we provide a decomposition of the sources of productivity growth over time, where we are interested in exploring the relative importance in aggregate productivity change of firm-level changes in productivity, changes in firms' market shares, and changes driven by the entry and exit of firms.

In terms of the structure of the paper we first provide a brief overview of the Moroccan policy environment. We then turn to our regression analysis, both direct and indirect, which focuses on the determinants of the changes in firm-level productivity. We then present the results of the decomposition analysis, which allows us to consider the importance of reallocation effects. The final section concludes.

2. Moroccan Policy Environment

Following independence in 1956, Moroccan policy was based on import-substituting industrialisation and agricultural self-sufficiency in a highly protected domestic market. Following a balance of payments crisis in 1983, Morocco virtually eliminated quantitative restrictions on imports and announced planned reductions in maximum tariffs from 165% to

[1] We gratefully acknowledge the help of Marian Dovis who supplied us with the programs for this procedure.

45% over a 6-year period. Further impetus to liberalisation has come from the multilateral and regional trade agreements, signed with different partners since the middle of 1990s, and following Morocco's joining the WTO in 1995. These include a quadrilateral FTA with Tunisia, Egypt and Jordan (1995), which expanded in following years to include other Arab states; a bilateral FTA with Turkey; the EU-Morocco Association Agreement (1996); an FTA with the US (2004); with Turkey (2006), and the Agadir Agreement with Jordan, Egypt and Tunisia (2004). Morocco has also signed further trade and investment agreements with a range of countries in Eastern Europe, Asia, Latin America and Africa.

A key objective of this liberalization process was to stimulate higher rates of economic growth and development, and to achieve this through closer links to the EU via the Barcelona process. Not surprisingly then, Moroccan trade is heavily dominated by Europe, which is the destination and origin of more than three-quarters of exports and imports. France is the main trading partner, taking over one-third of exports and providing over one-fifth of imports. Spain is the second trading partner, typically taking 16-18% of exports and providing 10-12% of imports. The UK, Italy and Germany are other important trading partners. It is important to note, that the process of liberalisation with the EU is asymmetric – Morocco has duty free access to the EU for all manufactured goods (hence agriculture is excluded), while it is reducing its tariffs on the EU's exports. This process of closer integration is now moving to a new phase with the introduction of the EU's Neighbourhood Policy.

Since the mid-1990s therefore Morocco has much more actively sought to integrate its economy in the world trading system, and this is reflected in the decline in tariffs over this period as given in Table 1. Data on nominal tariffs are available only for the years given. From the table we see substantial reductions in tariffs, especially following the entry of Morocco into the WTO in 1995. The increase in some tariffs after 2000 arises from the tariffication of quotas and other non-tariff barriers. By 2002 tariffs remain high ranging from 24%-50%. The biggest declines in protection are in Textiles and Electrical where the reductions were 74% and 58% respectively, and the smallest declines were in Food products (28%) and in Leather goods (29%). It is worth noting however, that despite the reduction in tariffs there are other taxes in place on imports into Morocco. Hence the level of tariffs tends may understate the true extent of protection in the economy.

Table 1: Moroccan Tariffs

	code	1993	1997	2000	2002
Food	15	72	61	52	50
Textiles	17	92	61	38	39
Clothing	18	99	71	50	50
Leather	19	60	50	43	46
Chemical	24	47	35	26	24

R&P	25	61	48	38	44
Electrical	31	65	37	17	26

Source: Trains database

While trade reform, primarily for manufactured goods was clearly seen as an important means of achieving improved economic performance, there was also a recognised need for this to be coupled with domestic institutional reform. In addition there have been a range of other reform initiatives, which include a privatisation process launched in the late 1980s largely focussed on hotels, road transport, petroleum distribution, petrochemicals, housing, textiles, cement and subsequently power generation, oil refining and telecommunications; a reform of the business environment and the judiciary, as well as a modification of the labour code and the labour legislation in 2003.

3. Data and Methodology

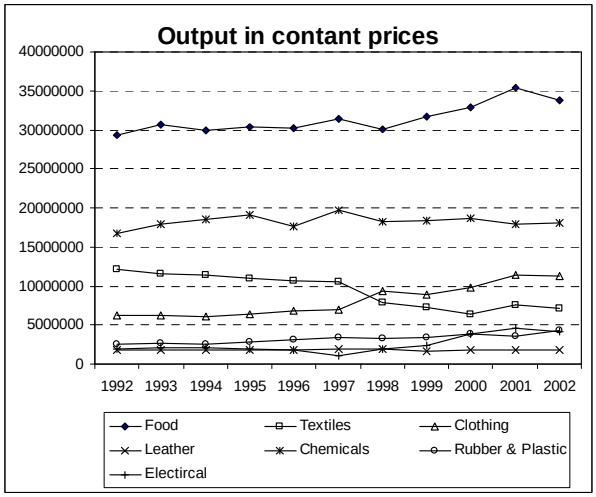
The data used in this paper is based on the Moroccan Annual Census of Manufacturing for the period 1990-2002. The annual census in principle covers all manufacturing firms with no size limitation. It contains information on sales, added value, output, exportations, employment, date of creation, location, investment and 4-digit industry code using the Moroccan Nomenclature of Economic Activities (NMAE). We have used 2-digit NMAE output and added value price indices to deflate production and added value. For a subset of firms we also have access to a much more detailed dataset, entitled FACS, for the years 1998-1999. The capital stock is only available for the subset of firms that are both contained in the census and in the FACS. For that subset of firms, the capital stock is available only for years 1998 and 1999. To obtain the stock of capital for the remaining years of the sample (1990-1997 and 2000-2002), we used the available data on investment. We used the perpetual inventory method, and considered a depreciation rate of physical capital of 6%. In order to obtain a measure of the stock of capital of the remaining firms – those not included in the FACS, we used the 'uvis' imputation technique, introduced by Royston (2004). This technique consists of estimating a linear regression model for the missing variable (the stock of capital), as a function of a number of relevant covariates (the level of investment, and the level of output of the firm). The capital stock for those firms with missing data is imputed using the prediction of that model, based on the values of the relevant covariates. (For a detailed exposition of this technique, see Royston, 2004).

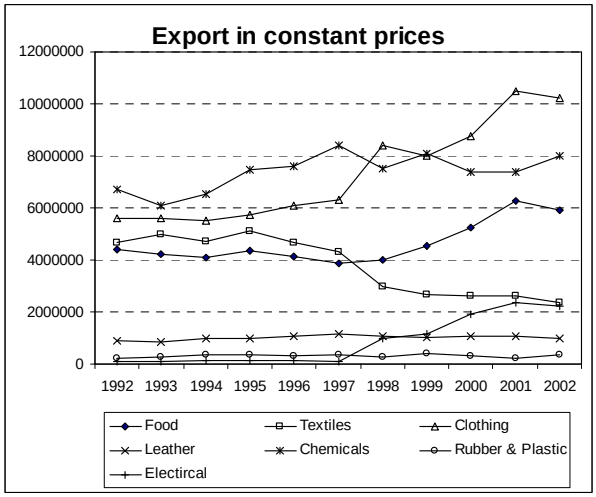
Partly because of these data constraints, in this paper we focus on seven key manufacturing sectors in the Moroccan economy. These are: Textiles, Clothing, Leather, Food Processing, Chemicals, Electrical, and Rubber & Plastics. After some considerable cleaning of the

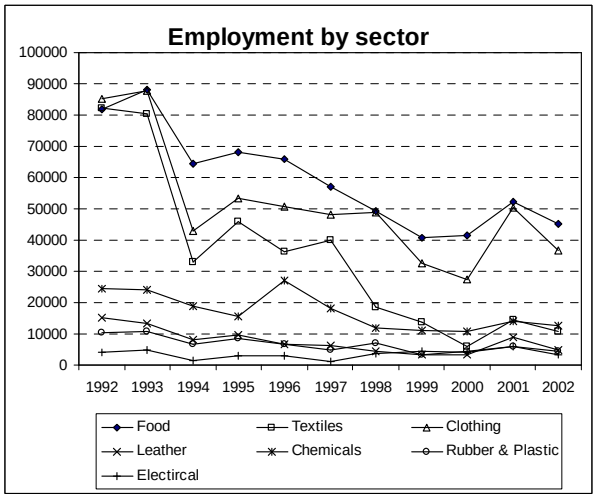
dataset we end up with an unbalanced panel containing 44,258 observations and 7,352 firms.

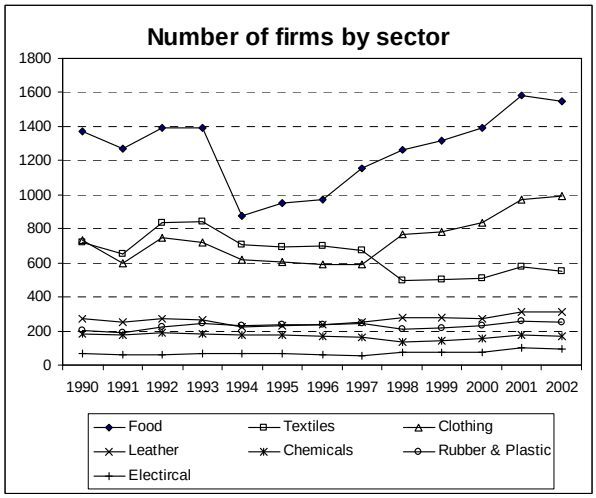
The figures below provide some important information with regard to the evolution of output, exports, employment and firm numbers in the seven sectors. The most important sectors in terms of output are Food, and Chemical throughout this period, who account for 41% (42%) and 24% (22%) respectively of total output in 1992 (2002), with the former seeing a growth rate of output of 15% and the latter of 8%.

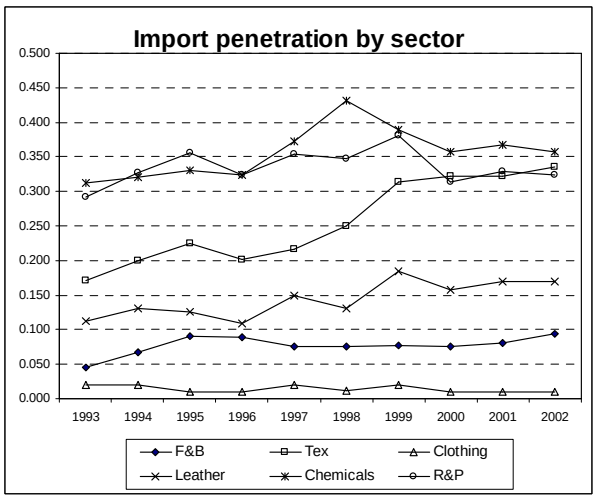
Figure 1


Output in contant prices
40000000
35000000
30000000
25000000
20000000
15000000
10000000
5000000
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002
Food
Textiles
Clothing
Leather
Chemicals
Rubber & Plastic
Electircal


Export in constant prices
12000000
10000000
8000000
6000000
4000000
2000000
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002
Food
Textiles
Clothing
Leather
Chemicals
Rubber & Plastic
Electircal


Employment by sector
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002
Food
Textiles
Clothing
Leather
Chemicals
Rubber & Plastic
Electircal


Number of firms by sector
1800
1600
1400
1200
1000
800
600
400
200
0
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002
Food
Textiles
Clothing
Leather
Chemicals
Rubber & Plastic
Electircal


Import penetration by sector
0.500
0.450
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
1993 1994 1995 1996 1997 1998 1999 2000 2001 2002
F&B
Tex
Clothing
Leather
Chemicals
R&P

In 1992 the third most significant sector was textiles with a share of output of 17%, which had declined to 9% in 2002. This decline in share arose from an increase in the import penetration rate from 17% to over 33%, which resulted in a decline in production of just over 40%. The sector with the biggest rate of increase is clothing which sees output rise by 78%, and its share of output to rise from 9% to 14% and very low and declining rates of import penetration. Output of leather remains fairly constant, while import penetration rises from 11% to 17%; and both Electrical, and Rubber and Plastics see output expand.

The substantial increase in output in clothing is clearly being driven by a marked increase in exports which rise by over 80% in real terms over the period and with the share in total exports rising from 22% to 34%. Interestingly this occurs with an expansion in the number of firms by 33%, and substantial increases in output per firm of over 30%, but a decline in total employment of over 50%. This suggests that that the industry may have moved to substantially more capital intensive techniques over the time period; the same process is consistent with productivity gains, but as our results subsequently suggest there is little evidence of this. The other key sectors are Chemicals where exports rise by 19%, while the export share declines from 32% to 27%. This is an industry which witnesses a decline in employment of nearly 50%, and a modest decline in the number of firms. This again could indicate a switch to more capital intensive techniques and an increase in output per firm of 18%. The food sector see exports fall for the first part of the period followed by a rise of over 50% from 1997 onwards, with a share in exports in 2002 of 20%. Once again employment falls substantially (by over 40%), and the number of firms rises slightly by 11%. In consequence output per firm increases only marginally over the time period (4%).

4. Direct and indirect analysis of the determinants of productivity.

In this part of the paper we turn to the analysis of the determinants of firm-level productivity growth, and where we are particularly interested in the relationship between trade on both the import and export side and productivity. We pursue two empirical strategies – a direct method and an indirect method.

First we estimate the impact of trade variables – on both the export and the import side - on firm level productivity but where we control for the likely simultaneity biases which may arise because firms typically make input choices with knowledge of their own productivity, and because both import protection and exporting may also be endogeneous. The methodology employed here is an extension of the Olley & Pakes methodology (2003). Secondly we utilise

the indirect approach, which first requires the estimation of a production function (while controlling solely for input-endogeneity) and where the residuals provide a measure of firm level productivity; and secondly we estimate a productivity equation, where the explanatory power of a number of variables can be examined.

Table 2 below gives the results from the direct estimation approach, where we explore the implications of controlling for endogeneity on both the export and the import side. The table gives the summary results for a large number of regressions, and where all variable which are significant at either the 1% or 5% level are given in bold. We test various specifications where the endogeneity of tariffs and the import penetration ratio at the sectoral level, and the export penetration ratio at the firm level, both with and without lags; as well as with and without sectoral fixed effect is explored. We also include firm-level market share, the degree of concentration (Herf), and the age of the firm as explanatory variables.

On the export side the key variable of interest is the firm's export share (XR), and on the import side we have two possible variables – tariffs and the import penetration rate (IPR) – each of which are defined at the sectoral level, at either the 2 or 4-digit level. We find that even with correcting for the possible simultaneity bias the firm export share is always positive and significant. This is also true where we consider the export share lagged by one period. This is an interesting result as a number of previous studies have argued that the positive correlation between exporting and productivity is because it is the more productive firms which succeed in international markets and hence end up exporting. Here we find direct evidence that exporting itself leads to growth productivity, but that the effects are typically small. An increase in exports of ten percentage points leads to an increase in productivity of the order of 0.5% - 0.8%.

One would normally expect that reductions in tariffs, or an increase in import penetration would lead to increases in productivity as the economy is opened up to more competition and as firms also have improved access to intermediates. Hence, the expectation is that the coefficient on tariffs would be negative and that on import penetration positive, and this result is corroborated in a number of recent studies (eg. Fernandez, 2007). The results without sectoral effects (the first row of each panel) do suggest that lowering tariffs is associated with higher productivity levels, however once again the coefficients are small – a ten percentage point reduction in tariff increases productivity by less than 1%. In the regressions with sectoral dummies at either the 2 or 4-digit level tariff reductions no longer impact on productivity. This suggests that it is more that sectors with lower tariffs tend to be more productive, rather than that tariff reductions are associated with firm-level increases in productivity.

Table 2: Estimation results – direct approach

Specification	L	K	Mat	Market Share	Herf	Age	Tariffs	Import Penetration Rate (IPR)	Export ratio (XR)	IPR lag	XR lag
XR Endo & TP Exo	**0.257**	**0.037**	**0.689**	0.012	0.000	**0.002**	**-0.098**		**0.074**		
XR Endo & TP Exo Sect Dummies	**0.280**	**0.031**	**0.675**	0.013	0.000	**0.002**	-0.019		**0.063**		
XR Endo & TP Exo ISIC Dummies	**0.301**	**0.029**	**0.645**	**0.024**	**0.000**	**0.002**	-0.012		**0.067**		
IPR & XR Endo & TP Exo	**0.253**	**0.038**	**0.687**	**0.031**	**0.000**	**0.003**	**-0.106**	-0.021	**0.067**		
IPR & XR Endo & TP Exo Sect Dummies	**0.284**	**0.031**	**0.668**	**0.038**	**0.000**	**0.002**	-0.020	-0.013	**0.058**		
IPR & XR Endo & TP Exo ISIC Dummies	**0.299**	**0.028**	**0.644**	**0.028**	**0.000**	**0.002**	-0.011	-0.012	**0.078**		
IPR Endo & TP Exo	**0.259**	**0.037**	**0.695**	**0.031**	**0.000**	**0.002**	**-0.084**	-0.043			
IPR Endo & TP Exo Sect Dummies	**0.292**	**0.033**	**0.677**	**0.043**	**0.000**	**0.001**	0.003	-0.045			
IPR Endo & TP Exo ISIC Dummies	**0.311**	**0.028**	**0.649**	**0.026**	**0.000**	**0.001**	0.009	0.015			
IPR Endo & TP & XR(-1) Exo	**0.251**	**0.039**	**0.694**	**0.032**	**0.000**	**0.003**	**-0.090**	-0.030			**0.047**
IPR Endo & TP & XR(-1) Exo Sect Dummies	**0.282**	**0.033**	**0.675**	**0.047**	**0.000**	**0.002**	-0.009	-0.025			**0.096**
IPR Endo & TP & XR(-1) Exo ISIC Dummies	**0.300**	**0.029**	**0.646**	**0.030**	**0.000**	**0.002**	-0.015	0.042			**0.113**
XR Endo & TP & IPR(-1) Exo	**0.256**	**0.037**	**0.689**	0.013	0.000	**0.002**	**-0.113**		**0.068**	-0.030	
XR Endo & TP & IPR(-1) Exo Sect Dummies	**0.280**	**0.031**	**0.675**	0.014	0.000	**0.002**	**-0.041**		**0.061**	**-0.082**	
XR Endo & TP & IPR(-1) Exo ISIC Dummies	**0.300**	**0.028**	**0.646**	**0.024**	**0.000**	**0.002**	-0.003		**0.062**	0.036	
TP & XR Endo	**0.259**	**0.032**	**0.688**	**0.020**	0.000	**0.002**	0.002		**0.049**		
TP & XR Endo Sect Dummies	**0.280**	**0.030**	**0.674**	0.013	0.000	0.002	-0.007		**0.052**		
TP & XR Endo ISIC Dummies	**0.300**	**0.028**	**0.645**	**0.021**	0.000	**0.002**	0.000		**0.056**		
TP & IPR Endo	**0.262**	**0.034**	**0.692**	**0.043**	**0.000**	**0.002**	0.006	**-0.065**			
TP & IPR Endo Sect Dummies	**0.293**	**0.028**	**0.676**	**0.051**	**-0.001**	**0.001**	0.009	-0.043			
TP & IPR Endo ISIC Dummies	**0.311**	**0.027**	**0.648**	**0.030**	**0.000**	**0.001**	0.008	-0.002			
TP Endo & IPRLAG & XRLAG Exo	**0.256**	**0.035**	**0.693**	**0.028**	**0.000**	**0.002**	0.027			**-0.057**	**0.054**
TP Endo & IPRLAG & XRLAG Exo Sect Dummies	**0.279**	**0.029**	**0.679**	**0.020**	0.000	**0.002**	0.005			**-0.054**	**0.090**
TP Endo & IPRLAG & XRLAG Exo ISIC Dummies	**0.300**	**0.028**	**0.647**	**0.023**	**0.000**	**0.002**	0.005			0.049	**0.109**

Notes: In column 1 above endogeneous variables are indicated by “Endo”; and the exogeneous variables by “Exo”
2-digit sectoral dummies are indicated by “ISIC”; and 4-digit dummies by “Sect”.

There is also no evidence that increased import penetration is associated with higher levels of productivity. Indeed if anything the reverse appears to be the case with the coefficient on the import penetration ratio and the lagged import penetration ratio being negative, although the coefficient in most specifications is not significant. This suggests that higher levels of productivity are typically associated with lower levels of import penetration, and that increases in import penetration may be associated with a decline in productivity. In terms of the pro-competitive and intermediate input story above this would appear counter-intuitive. It is of course possible that if firms produce under increasing returns to scale that an increase in import penetration can result in firms producing higher up their average cost curves and results in a decline in productivity. While this is possible, it is worth noting that our estimation results did not suggest the presence of increasing returns to scale. Other possible explanations are for example, as Rodrik has argued, that in the face or liberalisation firms reduce their levels of investment and hence productivity growth declines; or finally that in imperfectly competitive markets the results reflect a decline in price-cost mark-ups as opposed to decreases in productivity.

Finally, and consistent with other results in the literature there is also strong evidence that productivity rises with the age of the firm; and that increases in market share are associated with higher levels of productivity. Here too it is hard to establish the direction of causality and we have not controlled for possible endogeneity. However the typical presumption would be that more productive firms would typically have a higher share of the market, as opposed to that higher market share leads to higher levels of productivity. This is also consistent with Figure 3, in section 5 below where we see that firms that survive over the 12 years of the sample tend to be more productive than the average and increase their market share over the period.

Tables 3 and 4 give the results from the indirect estimation procedure. Here we report on the results for the regressions with firm level fixed effects and year dummies[2]. In the regressions in Table 3 our independent variable is the log of productivity. In Table 4 we then consider the role lagged values of our explanatory variables on the change in productivity.

A central issue which interests us here is the relationship between firm-level productivity and the efficiency of the firm relative to the productivity frontier. In Table 3 we explore this by the addition of two additional variables to our regressions. First, we include a variable (frontier) which gives the lagged average productivity of the five firms in each sector which are the most productive – these represent the productivity frontier (see also Griffith, Redding and

[2] We have also run the regressions with sectoral fixed effects, and with both firm-level and sectoral fixed effects, though the latter therefore only pick up the impact for those firms which change sectors. The results of these are consistent with the results presented and are therefore not reported here.

Simpson, 2006; Iacavone, 2008). The purpose of including this variable is to examine how changes in the productivity frontier impact on firm level productivity. Secondly, we include a variable which gives each firm's productivity relative to the frontier (DFF).

Table 3. Effect of trade policy on productivity (firm fixed effects)

Dependent variable: $\ln(TFP_{it})$

	(1)	(2)	(3)	(4)	(5)	(6)
Lagged tariff	-0.001**		-0.001***	-0.001***	-0.001**	-0.001***
	[0.000]		[0.000]	[0.000]	[0.000]	[0.000]
Lagged export share	0.051***	0.059***	0.049***	0.044**	0.063***	0.048***
	[0.017]	[0.016]	[0.017]	[0.017]	[0.019]	[0.017]
Lagged marketshare	0.012*	0.014**	0.013**	0.013**	0.014*	0.013**
	[0.006]	[0.006]	[0.006]	[0.006]	[0.008]	[0.006]
Lagged herf	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Import penetration		-0.319***	-0.329***	-0.329***	-0.359***	-0.331***
		[0.030]	[0.032]	[0.032]	[0.034]	[0.032]
Export share				0.033*		
				[0.018]		
Lagged frontier						0.028***
						[0.006]
Lagged DFF					-0.012**	
					[0.005]	
Observations	18268	21804	18068	18068	15687	18068
Number of firm	3802	4859	3793	3793	3518	3793
R-squared	0.01	0.01	0.02	0.02	0.02	0.02

Standard error in brackets.
* significant at 10%, ** significant at 5%, *** significant at 1%.
All regressions include firm fixed effect, year dummies, a constant, firm age and age squarred. Frontier is in log. Tariff is in percent. Export share and import penetration are in decimal.

If we turn to the results we see that the market share is always positive and statistically significant. As there is a potential issue of endogeneity here, broadly speaking the results suggest that firms with bigger market share have higher productivity. The level of concentration of domestic output by industry (Herf) is always negative and statistically significant but the size of the coefficient is close to zero. Age is always positive with quite a high value of the coefficient, which suggests that over time firms increase their productivity. This is consistent again with Figure 3 reported in Section 5 below, where we look at the evolution of the productivity of surviving firms and entrants over our sample.

As with the results using the direct approach the coefficient on tariffs is once again negative and statistically significant but the size of the effect is very small indeed. We also get highly

comparable results with respect to the export share, and the export share lagged. The indirect approach also provides confirmation of the negative impact on productivity of increases in the import penetration rate, though now with a much larger coefficient, which suggests that an increase in import penetration of ten percentage points is associated with a reduction in productivity of just over 3% in all of the specifications.

We now turn to considering the relationship between firm level productivity and the productivity frontier. The coefficient on is positive and statistically significant. This provides some evidence that as the frontier expands, firm level productivity rises, and that firms benefit from the increased productivity of those at the frontier, and hence of productivity catch-up. There two possible interpretations of this. First that this represents a pro-competitive "Darwinian" of the sort mentioned by Melitz (2003) - if some firms are expanding the frontier the rest need to increase efficiency if they are to compete. Secondly that this represents a spillover effect.

If we look at the DFF variable, the coefficient is, not surprisingly, negative. As DFF gives the ratio of the frontier to each firm's level of productivity, and we are controlling for the location of the frontier, an increase in the distance (DFF) is associated with a decrease in productivity of the i-th firm.

There is an important theoretical and empirical literature on the effect of trade on technological diffusion and hence on firm-level productivity. For example Ederington and McCalman (2008) show that trade has a generally positive impact on the speed of technology diffusion. Aghion et.al (2009) suggest that the more productive firms will be able to respond more positively to the challenges posed by the threat of entry and to increase their productivity over time (the escape-entry effect). For the laggard firms, this threat discourages innovation and the productivity decreases (Schumpeterian effect). Hence trade liberalisation impacts on TFP depending on the initial efficiency of the firm relative to the productivity frontier. This issue is explored in Table 4 below. Here the dependent variable is now the change in productivity from one period to the next, and each of the explanatory variables are lagged one period. Hence we are exploring the extent to which, for example, tariffs in period *t-1*, might have impacted on the change in productivity between *t* and *t-1*. We include a variable which gives each firm's productivity relative to the frontier (DFF). In these regressions we explore the impact on the productivity of all the non-frontier firms.

There is here a potential issue of endogeneity which needs to be addressed, as we have the lagged value of firm level productivity on both sides of the regression equation. In order to be confident in our results we deal with this issue in several ways. The first two columns of Table 4 give the results for a standard pooled OLS regression, and where we include firm

level fixed effects. It can be seen that here we include both DFF and the interaction between DFF and tariffs. The purpose of the interaction is to see if the impact of tariffs varies depending on the firm's distance from the frontier. In the third column of the table we present the results where we have instrumented for the possible endogeneity of both the DFF and the DFF*tariff variables, where we have used lagged values of each of these as instruments.

Of particular interest in these first three columns are the coefficients on DFF and on the DFF variable interacted with tariffs. The impact on lnDFF is positive hence indicating that firms who lag behind tend to catch up with the more productive firms. In order to assess the impact of tariffs on firm-level productivity we now need to consider the coefficient on tariffs as well as the interacted variable[3]. The results for each of these three regressions, and contrary to the existing literature indicate that tariffs increase the productivity of firms who are further away from the frontier, as opposed to those close to the frontier. For the IV regression, this is where the ratio of the productivity frontier to the firm is greater than 4.69. .

In the fourth column of the table we approach this issue somewhat differently. Here we have taken the DFF calculation, and we have divided the sample of firms into quartiles based on the DFF distribution, with those furthest away from the frontier being in the fourth quartile. We then construct a set of dummy variables for each of the quartiles, and run the regression with the dummy variables, and the dummy variables interacted with the tariff. By using quartile dummies we therefore avoid the problem of endogeneity. Finally, in the last column of the table we take the productivity level of each firm, and on the basis of this divide the firms into deciles, and then construct dummies on these deciles. The results by quartile and by decile corroborate those of earlier. In column four we see that that it is only for these firms in the third and fourth quartiles that there is a significant coefficient on the interaction of the dummy with the tariff. In column 5 the deciles have been organised by the level of productivity so now the least productive firms are in the first decile, and the most productive in the last decile. Once again we find that the interaction term is only significant for the least productive firms. It is also worth noting that as you move through the deciles there is a diminishing value of the coefficient on the DFF deciles, once again suggesting productivity catch-up.

[3] As the coefficient on the interaction term is negative tariffs impact positively on firm level productivity where the distance from the frontier (log(DFF)) is lower than the ratio of the coefficient on tariffs with respect to the interaction term.

Table 4: Changes in productivity and the distance from the frontier

Dependent variable: Δ ln(TFP_{it})

	FE	OLS	IV	Quartile	Decile
Lagged market share	-0.017	0.159	-0.013	0.0104	0.007
	-0.34	(5.47)**	(0.12)	(2.34)**	(1.89)*
Lagged herf	0	0	0.000	-0.0002	0
	-0.64	(4.59)**	(0.32)	(2.99)***	(1.85)*
Lagged tariff	0.005	0.002	0.034	0.0004	0.0009
	(7.43)**	(6.79)**	(5.37)***	-0.96	(1.99)**
Lagged import penetration	0.086	0.184	-0.001	0.1813	0.043
	-1.88	(8.69)**	(6.64)***	(4.67)***	-1.56
Export share	0.014	0.054	0.017	0.0392	0.029
	-0.55	(6.71)**	(4.58)***	-1.55	-1.27
DFF	0.52	0.332	-0.452		
	(19.60)**	(27.83)**	(4.35)***		
DFF*tariff	-0.003	-0.002	0.022		
	(8.50)**	(10.76)**	(0.71)		
Q2				0.3016	
				(14.60)***	
Q3				0.512	
				(21.30)***	
Q4				0.774	
				(26.39)***	
Q2*tariff				-0.0003	
				-1.09	
Q3*tariff				-0.0007	
				(2.27)**	
Q4*tariff				-0.0007	
				(1.87)*	
D1					(31.85)***
					1.073
D2					(30.26)***
					0.935
D3					(26.90)***
					0.875
D4					(24.27)***
					0.762
D5					(22.78)***
					0.687
D6					(20.78)***
					0.577
D7					(17.73)***
					0.477
D8					(15.02)***
					0.353
D9					(10.94)***
					0
D1*tariff					(2.38)**
					-0.0013
D2*tariff					-1.31

					-0.001
D3*tariff					(2.01)**
					-0.001
D4*tariff					(2.57)**
					-0.0014
D5*tariff					(1.75)*
					-0.001
D6*tariff					-1.64
					0
D7*tariff					-0.95
					0
D8*tariff					-0.81
					-0.001
D9*tariff					-1.44
Observations	15886	15886	14605	15760	17744
Number of firm	3560		3134	3548	3604
R-squared	0.18	0.12	0.01	0.24	0.38

Standard error in brackets.
* significant at 10%, ** significant at 5%, *** significant at 1%.
All regressions include a constant, firm age and age squarred. DFF is in log. Tariff is in percent. Export share and import penetration are in decimal.

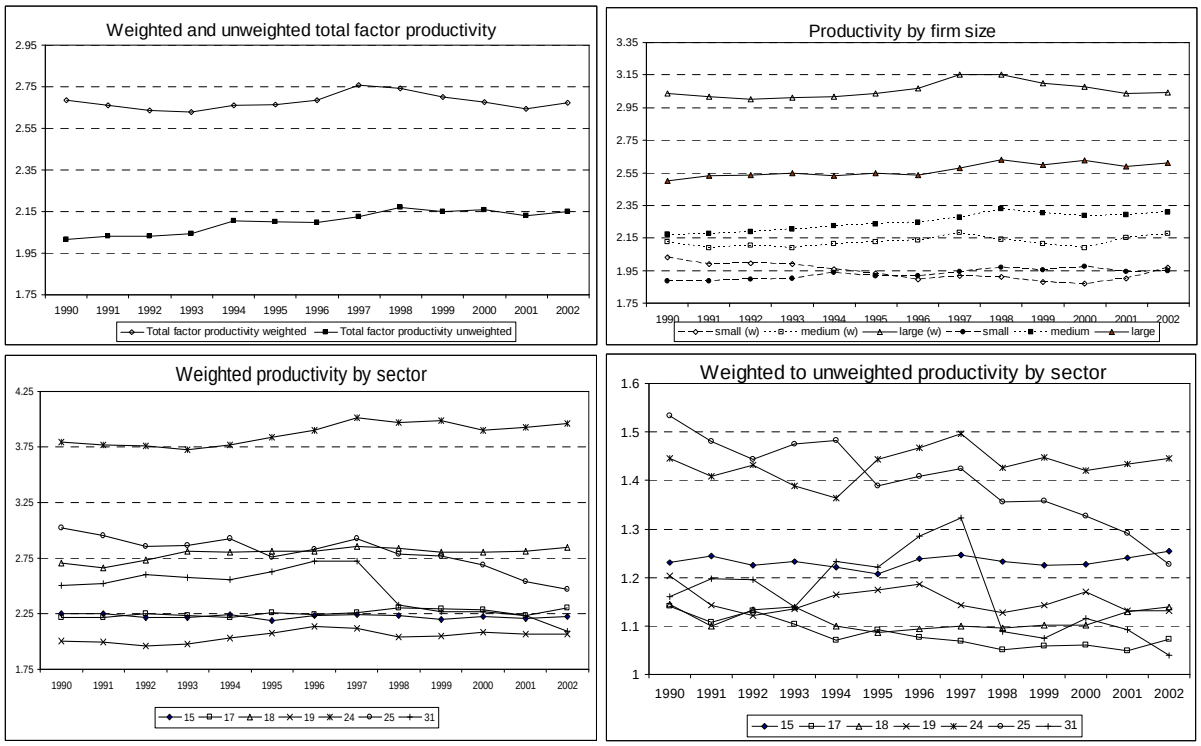
5. Productivity Growth and its decomposition

We now turn to considering reallocation effects. The tables below give the productivity over time in aggregate, by size of firm, and by sector. These productivity levels are based on the (log) total factor productivity as described above where we control for input endogeneity. We calculate a weighted average of firm productivity, using the share of output in total output as weights. If we turn first to the top panel we see that productivity growth over this time period was modest. Indeed if we compare 1990 with 2002 there is no change in weighted productivity over this period, while there is a small rise in un-weighted productivity – which over the time period rose by 16%. Of course it is possible that the low reported growth in productivity is being driven by price changes over time. While we cannot control for this perfectly, we do have sectoral level price indices for the Moroccan economy which we use to deflate all the relevant value series, and it is therefore unlikely that price effects are driving these results.

The comparison between the weighted and the un-weighted is informative. As weighted productivity is greater than un-weighted this means that higher productivity firms have a higher share of the market. We also see that the weighted productivity remained constant while the un-weighted productivity rose. In turn this implies either that the lower productivity firms increased their market share by more than the higher productivity firms, or that the productivity of the lower productivity firms increased by more than the productivity of the higher productivity firms. This is interesting because one might expect more productive firms

to increase their share of the market, which would tend to increase the weighted average more than the un-weighted. This is not the case here. This suggests either that more productive firms did not increase their share of the market or that higher increases in productivity for the lower productivity firms were more significant.

Figure 2: Productivity change 1990-2002



If we look at the change in productivity by size class, the picture for large firms as the same as the aggregate trend, with weighted productivity unchanged between 1990-2002, while un-weighted productivity rises by just over 11%. For medium sized firms, interestingly the un-weighted productivity throughout the sample is greater than the weighted, which means that higher productivity on average firms have a smaller share of the market. However the un-weighted productivity again rises more than the weighted, which either suggests that lower productivity firms increased their market share, or that the productivity of the lower productivity firms increased by less than that of the higher productivity firms. For small firms the picture is more mixed with weighted productivity declining, un-weighted productivity rising, and with weighted productivity being greater than un-weighted only towards the very beginning of the period.

Finally, if we consider the changes by sector, there are four sectors (17, 18, 19, 24) for whom weighted productivity rises over the time period, while for the remaining three (15, 25, 31) productivity declines. For two of these (rubber and plastics, and electrical goods) the falls in

productivity are quite substantial being around 40%. Interestingly these are sectors which saw modest changes in employment, output, exports and import penetration over this time period. The sector with the biggest increase in productivity is clothing, where productivity increases by over 15%. As the bottom right panel above shows, this is a sector where there is very little change in the ratio of weighted to unweighted productivity over the time period. In contrast, there are several sectors which see a substantial decline in this ratio. These include textiles (17), leather (19), rubber and plastics (25), and electrical goods (31). This suggests it is primarily in these sectors that firms whose productivity is less than average may be increasing their market share. Conversely, the only sector where the ratio increases is Food and Beverages.

Figure 3 looks at the change in market share (by output) for four categories of firms – those who remain in the sample throughout the period (survivors); those who exit during the period (exiters); those that enter and then remain during the period (entrants); and those that enter and leave within the period (short-stayers). For the same categories of firms Figure 4 then gives the unweighted productivity. Several features are interesting here. First we see that survivor firms increase their share of the market from 57% in 1990 to 70% in 2002. Here it is interesting to note that on average the unweighted productivity of survivor firms is higher for each year of the sample than the productivity of each of the other categories. However, we also see considerable entry and exit over the period. Firms accounting for 43% of the market in 1990 have exited by 2002, while new entrants account for 30% of output. For the intervening years short-stayers account for about 5% of output.

Figure 3

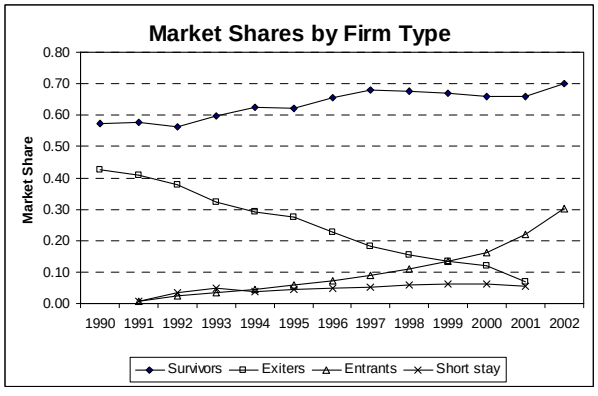
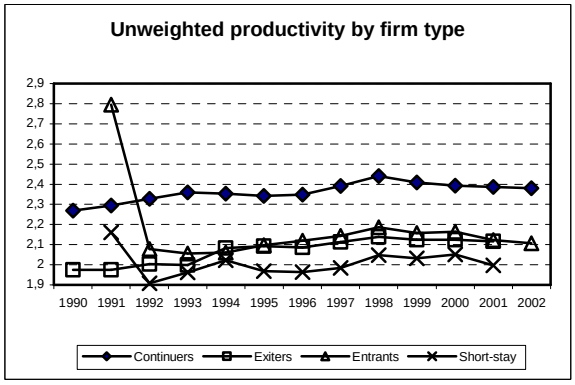


Figure 4



In terms of the productivity evolution we see that the surviving firms at best see a modest rise in their productivity over the time period.

We now turn to decomposing these changes in productivity. As discussed earlier the aggregate change in weighted productivity will depend in part on the change in any given firms's productivity, in part on any change in a firm's share of the market given its productivity, and in part on changes in aggregate productivity arising from the entry and exit of firms. There are several decompositions proposed in the literature which include Baily, Hulten and Campbell (1992), Foster, Haltiwanger & Krizan (2001), and Griliches and Regev (1995). Below we report only on the results for Foster et.al (which we refer to as FHK)[4]. They show that where aggregate manufacturing productivity in year *t*, P_t is given by,

$$(1)\quad P_t = \sum_i s_{it}\, p_{it}$$

and where s_{it} is the output or employment share of firm *i* at time *t*, and p_{it} is the (log) firm productivity, the change in manufacturing TFP ΔP_t, between periods t and τ is then:

$$(2)\quad \Delta P_t = \sum_{i\in C} s_{it-\tau}\,\Delta p_{it} + \sum_{i\in C}\left(p_{it-\tau} - P_{t-\tau}\right)\Delta s_{it} + \sum_{i\in C}\Delta p_{it}\,\Delta s_{it} + \sum_{i\in N} s_{it}\left(p_{it} - P_{t-\tau}\right) + \sum_{i\in X} s_{it-\tau}\left(P_{t-\tau} - p_{it-\tau}\right)$$

With "N", "X" and "C" representing entering, exiting and continuing firms respectively. The decomposition has five components. The first captures the firm-level changes in productivity for all firms who survive between periods t and τ. This term is often referred to as the within effect and measures internal restructuring. The second captures the "between" or "reallocation" effect between survivor firms. This gives the change in the firms' output shares multiplied by the difference between each firm's productivity $p_{it-\tau}$ and the average productivity in the base year $P_{t-\tau}$. In our results we further distinguish between those firms whose productivity was below the average, and those whose productivity was above average. The third term is a covariance term and measures the "compound effect" of the variation in firm-level productivity, and output shares changes. If its value is positive, this means that changes in productivity and changes in output shares were both positive or both negative; if this term is negative this means that productivity and output shares vary in opposite directions.

The fourth and fifth components represent the contribution of entering and exiting firms respectively. Entering (exiting) firms contribute positively (negatively) to the growth of aggregate industry productivity if their TPF is higher (lower) than the initial industry index.

[4] We have carried out the calculations using the other methodologies and they are fully consistent with the FHK results.

Once again we distinguish between those firms whose productivity is higher and lower than the average. The sum of the fourth and fifth terms measures the impact of net entry. The net entry effect will thus depend on the difference in the output shares between entrants and exiting firms and on the difference in the productivity of entering firms and exiting firms productivity from average productivity.

Table 5 below gives the results for the decomposition. We present results for the change in productivity over the entire time-period (hence the comparison is between 1990 and 2002) and then for the yearly average; we also give the results over the entire time period but only for exporter firms, and then the results by sector. For the aggregate results, the numbers represent the contribution of each element of the decomposition to the aggregate productivity change as a percentage of the base aggregate productivity level in 1990. This is also the case for the sectoral results, but where the base in each case is the sector's base level productivity. Where the figure is negative this indicates that this element of the decomposition decreased aggregate productivity.

Consider the first column of the table. From this we see that over the 12-year period there is very little change in firm-level productivity – indeed that firm-level productivity growth over the 12-year period was only 1.26% of 1990 productivity levels, and slightly higher for exporters (2.2%). The very low growth in firm level productivity is also true by sector, and on average for two sectors there is a decline in firm level productivity. In terms of reallocation effects, we see that over the 12-year period firms whose productivity was below average in 1990 *increased* their share of output and that those firms whose productivity was above average *decreased* their share of output, and this is also true of exporters. We also see a similar story in terms of the annual averages, though as these are annual averages the percentages are considerably smaller. For three sectors (15, 17, and 24) on average more productive firms increased their share of output. However, the changes in productivity as a result of these changes were again small. This result is perhaps surprising as one might expect that higher productivity firms would be more competitive and would increase their share of output. Given the high levels of entry over the period of the sample a plausible explanation which is consistent with the regressions is that entrants typically have lower productivity; but see that productivity and their shares rise in the years following entry. This catching up story is also consistent with the results in Table 4, with regard to the greater impact of tariff reductions on lower productivity firms.

If we consider entry and exit we again distinguished between those firms whose productivity was higher than average and those whose productivity was lower than average. Note that

the share, *S*, is by definition always positive. Hence, the entry of firms whose productivity is lower than average must lower average productivity and this term is always negative; the entry of firms whose productivity is higher than average must raise average productivity hence this term is always positive. In the results we see that the entrants are on average less productive, hence they lower the average productivity. Similar considerations apply to the contribution of exiters to aggregate productivity. The exit of firms whose productivity is less than average, raises average productivity, and the exit of firms whose productivity is higher than the average reduces average productivity. We find that the exiters are typically less productive than the average hence this offsets the decline in average productivity which arose because of the entry (on average) of firms less productive than the average. Once again, the middle panel indicates that these effects are not specific to the analysis being undertaken with a 12-year lag, and that the yearly average decompositions present a similar picture, and that there is little difference when considering exporters. What is also interesting is that this aggregate pattern of results is replicated in all the sectoral results. Entrants are typically less productive and this is most pronounced for sectors 25 and 31, and least pronounced for 17 (textiles), and leather (19). Similarly those that exit are typically less productive than the average.

Table 5: Productivity Decompositions

	Plant level change	**Reallocation effects**			**Co-variance term**	**Entry**			**Exit**			
	Total	Below av.	Above av.	Total	Total	Below av.	Above av.	Total	Below av.	Above av.	Total	**Total**
	12-year lag											
	1.26	-2.81	-0.38	-3.18	2.29	-5.95	0.92	-5.03	6.58	-2.28	4.30	-0.36
	Yearly average											
	0.10	-0.53	0.01	-0.52	0.37	-0.56	0.07	-0.49	0.75	-0.24	0.51	-0.03
	Exporters only											
	2,20	-2,25	-0,36	-2,61	2,59	-5,56	0,64	-4,92	6,54	-1,95	4,59	1,85
	By Sector											
15	0,05	-0,45	0,17	-0,29	0,23	-0,51	0,08	-0,43	0,67	-0,35	0,32	-0,12
17	0,03	-0,41	0,12	-0,29	0,59	-0,28	0,16	-0,12	0,44	-0,31	0,13	0,34
18	0,10	-0,57	-0,03	-0,60	0,85	-0,45	0,13	-0,31	0,56	-0,15	0,41	0,44
19	-0,33	-0,68	-0,01	-0,69	1,05	-0,26	0,17	-0,09	0,42	-0,09	0,33	0,27
24	0,29	-0,54	0,11	-0,43	0,18	-0,16	0,00	-0,16	0,49	0,00	0,48	0,37
25	-0,16	-0,84	-0,41	-1,25	0,12	-0,99	0,02	-0,97	1,08	-0,45	0,63	-1,63
31	0,19	-1,05	-0,10	-1,15	0,81	-2,03	0,32	-1,72	0,96	-0,46	0,50	-1,36

The picture that emerges then is very low levels of firm-level change in productivity, and the reallocation effects do not provide much evidence of increase productivity growth a la Melitz, Firms whose productivity was below average tend to increase their share of output, those

whose productivity was above average decrease their share; entry and exit tend to lower aggregate productivity which is driven by the significant amounts of entry and exit with entering firms typically having lower than average levels of productivity. We also find that for most years of the sample the productivity of entering firms is less than that of the exiters, and this is also true by sector. This raises the question as to why more productive are exiting, and why the levels of firm-level turnover are high? One hypothesis is that this is linked to underlying credit markets and financial factors (see for example, Greenaway et.al. 2007; Carluccio & Fally 2008). In particular these results may be indicative of constraints, for example with respect to credit, faced by incumbent firms, and possibly exacerbated by liberalisation, resulting in excessive exit which lowers aggregate productivity. At the same time the high level of entry of new firms, typically less productive than the exiters, suggests that the constraints may be impacting asymmetrically on incumbents in conmparison to entrants.

6. Conclusions

Theory and much empirical evidence suggest that increased openness should lead to increases in productivity. Those increases in productivity occur on both the export and import side and are driven by technology transfer and increases in competition resulting in the exit of inefficient firms and sectors, the growth of firm-level productivity, and the increasing share of more productive firms in the market. Morocco in the 1990's saw a period of substantial trade policy reform and other domestic reforms, aimed at increasing rates of economic growth. However, the evidence in this paper indicates that productivity growth over 1990-2002 for key manufacturing sectors has been minimal. With regard to firm-level changes in productivity, we control for possible endogeneity bias on both the export and import side, and show that that increased exports leads only very slightly to higher levels of productivity; and there is only weak evidence that domestic liberalisation increased productivity. Contrary to much of the existing literature, our results also show that, when taking into account firm-level heterogeneity, tariffs tend to increase the TFP of those firms who are further away from the productivity frontier.

The low levels of firm-level productivity change are corroborated by our decomposition analysis where we also consider market share changes as well as the role of entry and exit. Once again, and contrary to much of the theoretical and empirical Melitz inspired literature, we find that firms whose productivity was below average tend to increase their share of output, those whose productivity was above average decrease their share. There is also evidence of considerable entry and exit in aggregate lowering productivity as entering firms typically have lower levels of productivity. Hence while the mechanisms driving trade and productivity linkages are well documented, these results reinforce the need to understand more fully the circumstances under which they may or may not arise, and in particular the constraints which firms may face.

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