Empirical Essays in International Trade

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Document Version
Final published version

Publication date:
2012

COPENHAGEN BUSINESS SCHOOL
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DK-2000 FREDERIKSBERG
DANMARK

www.cbs.dk

ISSN 0906-6934

Print ISBN: 978-87-92842-90-9
Online ISBN: 978-87-92842-91-6

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Ph.d. Serie 32.2012

Copenhagen
Business School
HANDELSHØJSKOLEN

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The PhD School of Economics and Management

Ph.d. Serie 32.2012

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October 2012

PhD Thesis

Department of Economics

Copenhagen Business School

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1st edition 2012
PhD Series 32.2012

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Print ISBN: 978-87-92842-90-9
Online ISBN: 978-87-92842-91-6

"The Doctoral School of Economics and Management is an active national and international research environment at CBS for research degree students who deal with economics and management at business, industry and country level in a theoretical and empirical manner".

Acknowledgements

This dissertation was part of a research project on international trade financed by The Danish Council for Independent Research. I am deeply indebted to my supervisor, Pascalis Raimondos-Møller, for our coorperation, innumerous comments and suggestions, and for persistently pushing me to do better. I could not have asked for better guidance. Also a special thanks to my co-supervisor, Anders Sørensen, for his great help with access to classified registry data. During my PhD I stayed at Columbia University in the City of New York. My deepest appreciation to Eric Verhoogen for arranging my stay and for introducing me to Madhura Maitra, senior PhD student, with whom I wrote the second chapter. The stay was very valuable to my PhD. Thank you Madhura, for many lengthy discussions and your friendship.

I sincerely appreciate detailed comments from my pre-defence committee, consisting of Lisbeth la Cour and Jan Rose Skaksen, chairman of the PhD committee. Furthermore I would like to thank colleagues and PhD fellows for contributing to a fruitful, inspiring, and helpful research environment in the past three-four years. Special thanks to Sebastian Schwenen, Mario Daniele Amore, and Petter Berg. The chapters of my dissertation also benefitted considerably from comments during seminar presentations at the ETSG Conference 2009, 2010, 2011; CESifo 2009 Global Economy Conference; the joint PhD workshops at the ECON departments at Copenhagen Business School (CBS) and University of Southern Denmark; Asian Diversity in a Global Context (Globalization and trade) at University of Copenhagen (2010); Brown Bag Seminars at ECON/CBS; and Columbia Trade Colloquium at Columbia University.

Finally, I would like to thank my wife, Emma, for always encouraging me to pursue my dreams, and to travel with me halfway around the world, to make the most of my PhD.

I am solely responsible for any errors in my thesis.

Contents

Summary

The thesis consists of an introduction followed by three numbered chapters (independent papers). It covers topics in international trade, and in different ways the thesis investigates aspects of heterogeneity. The first chapter is coauthored with Pascalis Raimondos-Møller. The version of this chapter is published in the CESifo Working Paper Series and serves as the final background paper for the compressed journal article published in Review of Development Economics, May 2012. The second chapter is coauthored with Madhura Maitra, senior PhD student at Columbia University at the time. The third chapter is a solo paper.

In the first chapter we introduce a traditional macro model of trade and change the competitive environment by introducing state-owned enterprises. We also include heterogenous households to analyze effects on the income distribution. The chapter focuses on Vietnam's accession to the World Trade Organization (WTO) in 2007. Upon entry, Vietnam was granted an accession period lasting till 2014. During this period tariffs would have to fall according to the accession agreement. This first chapter evaluates this 2007-2014 trade liberalization by building an applied general equilibrium model and calibrating it to the Vietnamese data. The model pays careful attention to the fact that Vietnam has many state-owned enterprises that do not behave in a profit maximizing way. The model simulations show that the WTO imposed tariff reforms will reduce the overall welfare level of the Vietnamese households. Moreover, the biggest loss of income will take place among the poor rural households in Vietnam. We propose other tariff reforms that both raise overall welfare and reduce income inequality.

In the second chapter we analyze wage effects from offshoring using the Danish worker-firm panel of the universe of Danish firms and workers. We limit the main analysis, however, to manufacturing firms. Our motivating point of departure is that offshoring firms are found to pay

higher average wages than purely domestic firms. In this chapter we offer a unifying empirical approach by capturing the different channels through which offshoring may explain this wage difference: (i) due to change in the composition of workers (skill composition effect), and (ii) because all existing workers get higher pay (rent sharing effect). Using Danish worker-firm data we explain how much each channel contributes to higher wages.

To estimate the causal effect of offshoring on wages we use China's accession to the WTO in December 2001— and the soon after boom in Chinese exports —as positive exogenous shocks to the incentive to offshore to China. Both skill composition and rent sharing effects are found to be important in explaining the resultant gain in wages. We also show that the firm's timing in the offshoring process determines the relative importance of a channel. For firms offshoring to China in 2002 but not in 1999, only rent sharing explains the gain in wages. For firms offshoring to China both before and after China's WTO accession the wage increase is explained mostly by the skill composition effect. Moreover, these patterns are not discernible from the measures of skill composition and rent sharing available in typical firm level datasets – like ratio of educated to uneducated workers and sales per employee.

In the third chapter I utilize unique data on firm level monthly trade featuring product and destination information. I use these data to analyze the extent of pricing-to-market among Danish exporters. The topic revolves around a very particular challenge that exporters face: to price their exports in a foreign market when the exchange rate changes. As opposed to annual trade flows, monthly trade flows bring us closer to the transaction level where firm decisions are actually made. Furthermore, they provide more precise measures of prices than aggregate, annual data do. I find that the utilization of monthly data does add new information about the average level of pricing-to-market, and the differences between long-run pricing-to-market and short-run pricing-to-market. Furthermore, I find industry differences in pricing-to-market

in terms of the magnitude (zero to complete pricing-to-market) and the timing (when do firms changes prices), and that pricing-to-market is stronger on high-income markets. As discussed in detail in the chapter, all results are in-line with predictions of several theoretical contributions to the literature on pricing-to-market and exchange rate pass-through.

Dansk resume

Afhandlingen består af en indledning efterfulgt af tre nummererede kapitler, som hver især udgør selvstændige papirer. Fælles for alle kapitler er, at de relaterer til emner inden for forskning i international handel og berører forskellige former for heterogenitet. Endvidere er de alle kvantitative studier, hvor der enten bruges simulationsmetoder eller udføres økonometriske estimationer. Det første kapitel er forfattet sammen med Pascalis Raimondos-Møller. Denne version af kapitlet er publiceret i CESifo Working Paper Series og er det endelige baggrundspapir for den mere kompakte artikel publiceret i Review of Devolopment Economics, maj 2012. Det andet kapitel er forfattet sammen med Madhura Maitra, phd-studerende ved Columbia University på det pågældende tidspunkt. Det tredje kapitel er selvforfattet.

I første kapitel introducerer vi en traditionel makroøkonomisk handelsmodel og ændrer den konkurrencemæssige form ved særskilt at modellere statsejede virksomheder anderledes end privatejede. Vi modellerer også heterogene husholdninger for at kunne belyse effekter på indkomstfordelingen. Kapitlet fokuserer på Vietnams indtræden i verdenshandelsorganisationen (WTO) i 2007. Ved indtræden fik Vietnam frem til 2014 til at fuldføre processen. I perioden fra 2007-2014 skulle toldsatser så sænkes i henhold til gældende aftale. Vi evaluerer denne handelsliberalisering ved at opstille en anvendt generel ligevægtsmodel og kalibrere den til vietnamesiske data. Vi er i modellen særligt opmærksomme på de statsejede virksomheder, som den vietnamesiske økonomi er stærkt afhængig af, og som ikke har incitamenter til at udvise optimerende adfærd og dermed profitmaksimere. Simulationerne viser, at isoleret set så giver den forslåede toldreform ikke udsigter til velfærdsforbedringer. Særligt vil de store tabere være den fattige landbefolkning. Vi foreslår andre reformer, som generelt kan hæve den økonomiske levestandard og også sænke uligheden.

I det andet kapitel analyserer vi løneffekter af outsourcing til udlandet. Vi benytter Danmarks Statistiks registerdata over samtlige arbejdere på det danske arbejdsmarked og de virksomheder, de arbejder i. Vi begrænser dog vores hovedstudie til fremstillingssektoren. Vores motivation stammer fra det veletablerede faktum, at virksomheder, som outsourcer produktion til udlandet, i gennemsnit betaler højere lønninger end virksomheder, som ikke outsourcer produktion til udlandet. I dette kapitel viser vi, hvorledes man empirisk kan analysere forskellige, samtidige årsager til disse lønforskelle. De mulige samtidige årsager til ændringer i virksomhedernes gennemsnitslønninger, som vi analyserer, er (i) ændringer til kompetencesammensætningen og (ii) stigende profitabilitet, som øger alle lønninger. Den sidste årsag, eller effekt, benævnes *rent sharing* i litteraturen. Den første effekt benævnes *skill composition*.

For at skelne kausalitet fra korrelation anvender vi Kinas indtræden i WTO ultimo 2001 som et eksogent stød til incitamentet til at outsource produktion til Kina. Vi finder, at efterfølgende lønstigninger bunder i både skill composition- og rent sharing-effekter. Vi finder også, at effekternes relevans varierer for den enkelte virksomhed. Virksomheder, der allerede kendte til outsourcing af produktionen til Kina, var skill compostion-effekten den vigtigste forklaring. For virksomheder, der ikke tidligere havde outsourcet til Kina, var rent sharing-effekten udelukkende den forklarende årsag. Endvidere dokumenterer vi, hvorledes udnyttelsen af individdata inden for hver virksomhed, gør os i stand til at måle disse effekter, som man ikke ville kunne have målt ved udelukkende at anvende de mål, man typiske har til rådighed i et detaljeret virksomhedspanel, men som ikke indeholder persondata.

I det tredje kapitel udnytter jeg unikke, månedlige data, som beskriver danske virksomheders handel med udlandet på detaljeret produkt- og destinationsniveau. Jeg benytter disse data til at analysere danske eksportørers aggeren på udenlandske markeder i forhold til at tilpasse eksportprisen til gældende markedsvilkår. I litteraturen kaldes dette *pricing-to-market*. Nært

beslægtet er litteraturen om *exchange rate pass-through*, som beskæftiger sig med udslaget i importpriser, når valutakursen ændrer sig. Pricing-to-market berører den helt særlige udfordring, som eksportvirksomheder står over for, nemlig at prisfastsætte deres produkter på et udenlandsk marked, når valutakursen ændrer sig. Når kronen stiger i værdi, så bør en eksportvirksomhed alt-andet-lige sænke eksportprisen for at forblive konkurrencedygtig på det udenlandske marked, da prisen her ellers vil stige med kronen. Jeg undersøger, hvor stor priselasticiteten er i forhold til valutakursændringer, og om størrelsen på elasticiteten afhænger af virksomhedens position på det udenlandske marked.

Modsat årlige data, så giver månedlige data os muligheden for at komme tæt på transaktionsniveauet, hvor virksomhedernes beslutninger faktisk tages. Vi opnår samtidig et mere præcist mål for priserne, end tilfældet er det med aggregerede årlige data. Studiet viser, at anvendelsen af månedsdata har fordele over årsdata og bidrager til litteraturen om omfanget af pricing-to-market samt forskelle mellem kortsigtede og langsigtede pricing-to-market-beslutninger. Endvidere finder jeg forskelle mellem fremstillingssektorerne både i forhold til omfanget (fra ingen til fuld reaktion) og i forhold til reaktionstidspunktet, og så finder jeg, at pricing-to-market er mere udtalt på højindkomstmarkeder. Som det også uddybes i kapitlet, så understøtter resultaterne adskillige teoretiske bidrag indenfor litteraturen om pricing-to-market og exchange rate pass-through.

Introduction

The thesis covers topics in international trade that in different ways investigates aspects of heterogeneity. Identical for all three chapters is, that they are quantitative studies, either using computable simulations techniques or performing econometric estimations. The first chapter explores heterogeneity in a different way than the last two chapters, as it employs non-traditional methods in an otherwise classical, theoretical model. The international trade literature has focussed heavily on the heterogeneity of firms to explain the selection of exporters and importers (see Melitz, 2003, and Bernard, Jensen & Schott, 2007). The focus on firm heterogeneity and simultaneously the availability of firm-level data has given scholars great opportunities to investigate theoretical predictions while taking into account the unique behavior of every firm in the sample data. We say that we control for firm heterogeneity. Furthermore the availability of worker-firm panels has opened up for measuring not just firm effects but within-firm effects. Chapters 2 uses the unique Danish worker-firm panel but, while chapter 3 utilizes unique and new data on monthly firm level trade.

The first chapter can viewed as a comment on the use of quantitative measures of effects from liberalizing trade. The policy implications should raise concern about the theoretical foundation on which trade policy makers are often advised. Often models used to evaluate trade liberalization are neoclassical macro models of trade. In this chapter, coauthored with Pascalis Raimondos-Møller, we alternate a standard trade model (Ricardo-Viner) to include state-owned enterprises that are not profit maximizing but instead labor (and thus revenue and size) maximizing. We include heterogenous, representative households.

We then calibrate this model to the reality Vietnam was facing when entering the World Trade Organization (WTO) in 2007. We then simulate and evaluate the proposed liberalization (i.e. the move from the bound rates upon entering to the final rates by 2014) to demonstrate

that the settled liberalization (close to proportional cuts) does not improve welfare. We then evaluate traditional methods used to cut tariffs that in a perfectly competitive model is guaranteed to generate welfare improvements. However, these measures also fail when the proposed state-owned enterprise behavior is introduced. In fact, we show that subsidizing competitive imports to discipline state-owned enterprises generates massive gains. Furthermore, contrary to common arguments of trade as a poverty alleviator, we find that the population hurt the most by the proposed tariff cuts is the labor intensive agricultural sector that employs especially the poor rural population (i.e. the poorest of the poor). These findings are new to the trade and development literature and offer new views in an otherwise well-known discussion: is it appropriate to use competitive macro models to evaluate macro policies for developing countries?

The second chapter, coauthored with Madhura Maitra, investigates offshoring behavior of Danish firms using the unique Danish panel of the universe of firms registered in Denmark. We investigate the well-known question of why offshoring firms pay higher average wages. We provide a theoretical motivation, and an identification strategy that suggests the direction of causality to demonstrate that Danish firms that took up a new offshoring possibility (our treatment group) experienced positive differential wage increases compared to the control group.

We focus on manufacturing firms, but our results also hold for the full sample of firms. We offer a unifying empirical approach to disintangle two possible channels behind the higher average wage changes among offshoring firms: a rent sharing channel and a skill composition channel. So far in the literature, these channels have been explored separately. We carry out the analysis in two ways. First estimate we carry out estimations using only firm-level evidence and demonstrate that rent sharing effects are not discernible from typical firm-level panels. Then we utilize the worker-firm panel to construct a rent-sharing component in workers' wages between the worker and the firm. We then use this aggregate component of worker-firm rent sharing

at the firm level and find evidence of rent sharing. We then go on to show that firm average wages increase through the two channels in different ways depending on the timing of offshoring to China. Firms that offshored to China before China entered WTO, seem to predominantly change average wages by trimming the workforce. However, firms new to offshoring to China experience wage increases completely through rent sharing, suggesting that these firms harvest low hanging fruits of cost improvement.

We utilize China's entry into the WTO as an exogenous shock to the incentive to offshore. Since we started writing this chapter, this identification strategy has become increasingly used and recognized. Our findings, the application of the econometric methods, and the identification strategy are novel to the literature.

The policy conclusions are that the concern that low-skill jobs are threatened is, once again, confirmed. Other studies show that workers experiencing job separation from offshoring enter lower wage paths. However, we show that workers that stay in the firms enter *higher* wage paths and thus benefit from firms offshoring. What policy makers should take from this study is that the differential wage increase is far from just a story of cost cutting by changing the skill composition. In some cases the story could be completely driven by increased profitability.

The third chapter follows a recent strand of literature that data re-investigates exchange rate pass-through and pricing-to-market. This study is novel in three ways: First, It uses high-frequent, detailed firm-level export data where other studies have used less frequent data. Second, it explores short-run and long-run pricing-to-market at the firm level which no other study has done. Third, it furthermore explores short-run and long-run aspects within industries and country types.

The discussion of PTM relates to the long-standing literature on incomplete exchange rate pass-through that is concerned with why import prices do not fully adjust to exchange rate

changes. This chapter takes on PTM using a unique data set that covers firm level trade at great detail at monthly frequency. These high frequent data offer the opportunity of a new view on what hides behind the time-aggregate estimates typically found using annual data. Annual trade flows are the sum of multiple decisions taken at different points in time. By moving to monthly trade flows we get closer to the transaction level where firm decisions are actually made. To see the benefit of that, note that annual data provide annual unit values — called prices in this literature. By being annual data, these prices are averages over the different prices the firm has charged during that year. Using monthly data, and thus monthly unit values, we can be almost sure that unit values are indeed close to the price specified in a particular export contract.

I find that the utilization of monthly data does add new information about average PTM, and the differences between long-run pricing-to-market and short-run pricing-to-market. Furthermore, I find industry differences in terms of the magnitude and the timing of pricing-to-market, and that pricing-to-market is particularly strong on high-income markets. As discussed in detail in the chapter, these results are in-line with theoretical predictions of choice of invoice currency and the associated pricing mechanism.

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[1] Bernard, A; Bradford Jensen; Redding, S; Schott, P (2007): “Firms in International Trade" Journal of Economic Perspectives

[2] Melitz, M.J. (2003): The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity, Econometrica, Econometric Society, vol. 71(6), pages 1695-1725, November

Chapter 1

Reducing tariffs according to WTO accession rules: the case of Vietnam

BY

Henrik Barslund Fosse & Pascalis Raimondos-Møller

Abstract: When Vietnam entered WTO in 2007 it was granted an accession period up to 2014. During this period tariffs would have to fall according to the accession agreement. This paper evaluates this 2007-2014 trade liberalization by building an applied general equilibrium model and calibrating it to the Vietnamese data. The model pays careful attention to the fact that Vietnam has many state-owned enterprises that do not behave in a profit maximizing way. The model simulations show that the WTO imposed tariff reforms will reduce the overall welfare level of the Vietnamese households. Moreover, the biggest loss of income will take place among the poor rural households in Vietnam. We propose other tariff reforms that both raise overall welfare and reduce income inequality.

JEL Codes: F14, F17, C68.
Keywords: Vietnam, WTO accession, trade reforms, state-owned enterprises.

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Acknowledgments: We wish to thank participants at the CESifo 2009 Global Economy conference and at the ETSG 2009 meeting for valuable comments and suggestions. Financial support from the Danish Social Science Research Council is gratefully acknowledged.
Published: This version was published as CESifo Working Paper 3628. A shorter version was published in Review of Development Economcis, May 2012.

1. Introduction

On January 11, 2007, and after 12 years of accession process, Vietnam became the 150th member of the World Trade Organization (WTO). Becoming a member of the WTO ultimately implies a binding tariff schedule. The Vietnamese accession process will be formally completed when a gradual reduction of the existing tariff rates reach the pre-determined final rates. This will be the case in 2014.

The present paper evaluates this accession-led trade liberalization using a computable general equilibrium (CGE) model calibrated to the Vietnamese economy. In doing that, special attention is paid to the existence of state-owned enterprises and how they affect the economy by large. Moreover, we pay attention to income distribution issues among heterogeneous households and we investigate how different trade liberalization schemes affect this distribution. While linking trade liberalization to income distribution is not by itself novel, doing that in the presence of state-owned enterprises and for a calibrated model of the Vietnamese WTO accession is, to the best of our knowledge, novel to the literature.[1]

In modelling state-owned enterprises we follow the approach adopted in several writings about state-owned enterprises in general, viz. that they do not maximize profits (see Schmitz., J., 1996; and World Bank, 2005). More in particular, we follow Whalley and Zhang (2006) who assume that state-owned enterprises maximize revenues. With prices being fixed by the world market (small open economy) this assumption implies that state-owned enterprises in reality maximize output and thus employment. As we will show, introducing such a state-owned enterprise behavior in an otherwise standard trade model of a small open economy alters considerably the welfare effects of different tariff reforms.

We will show that if the state-owned enterprises behaved as profit maximizers, the WTO accession tariff reforms would both increase aggregate real income and reduce income inequality — clearly, a win-win situation. However, with state-owned enterprises maximizing revenues, the WTO accession tariff reforms will end up doing exactly the opposite, viz. reduce aggregate income and increase income inequality. The same will be true for other well-known reform rules — the concertina rule (where the highest tariff is reduced to the second highest level) and the proportional rule (where all tariff rates are reduced by the same proportion). In other words,

[1] See Abbott et al. (2009) for a survey of this literature using Vietnam as the case of study. Similar to our paper, Ghosh and Whalley (2008) focus on Vietnam and trade liberalization under state-owned enterprices. However, both the model and the experiments they consider are quite different from ours (they apply a shirking model of state-owned enterprises that they use to analyze the case of zero tariffs).

all the well-known tariff reduction rules bound to fail when state-owned enterprises distort the market economy.

Given this distorting behavior of state-owned enterprises, one may want to know what kind of tariff reform would achieve the goals of higher real income and lower income inequality. We show that the main characteristic of this reform has to be a large and disproportionate reduction of the protection of the state-owned sector — in fact, we will show that if the imports of the goods produced by the state-owned enterprises are subsidized, both welfare and income distribution will improve. We will provide intuition for this and all other results after we explain what state-owned enterprises imply to the market equilibrium. Firstly, however, and in order to set the background for our model choices, we provide a brief description of the Vietnamese economy and the significance of the state-owned enterprises in that economy.

1.1. Vietnam. Vietnam is a country in change. It is turning global in many aspects – culturally, socially, and economically. Table 1 shows the change of the overall structure of the Vietnamese economy in the period 1990-2006, with manufacturing clearly increasing its GDP value added at the cost of the primary sector.

Year	Agriculture, forestry and fishing	Industry and construction	Service
1990	39	23	39
2006	20	42	38

Source: General Statistics Office of Vietnam

Table 1: Decomposition of GDP in Vietnam (pct.)

However, while industrialization has made manufacturing and services the predominant providers of value added, the income source of the majority of the Vietnamese population is still the primary sector. As of 2006, more than 58 % of the population were employed within these industries (see table 2).

Since the majority of the population, and especially of the lower-income households, is employed in the labour-intensive primary sector, this sector is of special consideration. That the poor people work in the rural areas is supported by looking at the urban-rural 0.37 Gini coefficient, implying that wealth distribution is skewed moderately towards urban Vietnam. Combined with a 0.28 Gini coefficient of rural Vietnam, this points towards a generally low, but even, rural per capita income level. Clearly, and as one would expect from a socialist country, the overall income inequality in Vietnam is relatively low — a 0.3 value places Vietnam between

Employment by kind of economic activity, pct. (2006)	
Agriculture and forestry	55.4
Fishing	3.4
Industry	12.7
Construction	4.6
Trade	11.5
Hotel, restaurant	1.8
Transport, storage and communications	2.9
Culture, health and education	4.0
Other services	3.7
UNDP Poverty Line (2002), pct.	29.0
UNDP Food Poverty Line (2002), pct.	10.9
UNDP Urban/Rural Gini coefficient	0.37
Urban	0.35
Rural	0.28

Source: General Statistics Office of Vietnam

Table 2: Employment, Poverty and Income Distribution

the Scandinavian countries (0.26) and the USA (0.408), and close to countries such as France, Canada, Australia and the United Kingdom. But Vietnam is a low income developing country. A growth in income inequality may be devastating for many Vietnamese families if the source of this growth is lower income at the bottom end of the income scale. According to the United Nations Development Programme in Vietnam, even though absolute poverty has been reduced considerably throughout the 90's, 29% of the population were still living below the poverty line in 2002 (UNDP VN, 2002). In rough numbers that is more than 23 million people in a country with more than 80 million inhabitants.

Focusing on the importance of state-owned enterprises it should be mentioned that from 1995 to 2006, state ownership of production facilities has decreased from 50% to 38%, household ownership of production facilities has decreased from 36% to 30%, while foreign investment ownership of production has increased from 6% to 17%. Moreover, this state production is very much focused in the industrial sector; in 2006, 75% of the state output was industrial output. Such predominance of state-owned firms can be explained by what the literature calls a Guanxi approach (Ashwill and Diep, 2005) — typically assumed for Chinese state-owned firms. Vietnamese culture exhibits — along with pervasive corruption — a system of relationship building similar to the Guanxi system in China. In such a system, a politically appointed management may build up prestige by securing many jobs for the locals in the local community. More importantly to the management, by managing a large enterprise it may increase its proceeds from

networking with other managers (under the assumption that the larger the firm you manage, the more important people you will network with). The management may also experience proceeds from networking with influential party members who politically motivated — directly or indirectly — facilitate a subsidy to the firm. Hence, by maximizing employment and size of the firm, the manager is assumed to maximize personal utility.

One of the focal points of the state-owned enterprise reform in Vietnam has been to reduce the number of typically small local government controlled firms (UNDP VN, 2006; Sjöholm, 2006). The local governed state-owned firms have been singled out as a way of channeling state resources to other purposes than intended. Equitization is conceived as the way of restructuring state-owned firms. By creating publicly listed firms, where the government may own only some shares, the government wants to make the state-owned enterprises partly dependent on competitive capital funding. In general, however, the high national dependency on state output seems to slow down the privatization process. Large SOEs seem so far to have been exempted from equitization. Moreover, the evidence of major sourcing of equities to non-governmental stakeholders has yet to be seen. The General Statistics Office of Vietnam (GSO) provides data for how many people are employed in state-owned production facilities, how many state-owned firms exist, but not how much they produce, what profits are, and e.g. which state firms are equitized and what governs the principle of foreign investments in these firms.[2]

On the basis of the above facts, we build a model where state-owned enterprises are explicitly taken into account within an otherwise traditional general equilibrium model of the Vietnamese economy. We also pay careful attention to heterogenous households and their source of income. In what follows, we describe in detail the model chosen.

2. The Model

2.1. Production. We model a specific-factor small open economy. There are four representative producers of four final goods in the economy: A competitive *primary* producer, y_P, a competitive (private) light manufacturer, y_l, a manufacturing *state-owned enterprise*, y_{soe}, and a rest-of-economy sector, y_{roe}.

[2]Moreover, even if one observes private share owners, these may in turn owned by a public agent. This is an often cited problem in the literature on assessments of Chinese state-ownership of publicly as well as (seemingly) privately held (off-listed) companies. As pointed out by Whalley and Zhang (2006) one example is Lenovo. The company is formally owned by Legend Holdings. However, Legend Holding is controlled by the Chinese Academy of Natural Sciences.

The production functions applied in the model are Cobb-Douglas:

$$y_j = A_j F_j^{1-\alpha_j} L_j^{\alpha_j} = \varphi_j L_j^{\alpha_j}, \quad j = p, l, soe, roe \tag{1}$$

where F_j is the specific factor of the respective sectors, and thus $\varphi_j = A_j F_j^{1-\alpha_j}$ is just a scalar.

Three of the sectors have identical structures but different inputs to production. In the primary sector, y_p, the single immobile factor is land, while in the two other competitive sectors the immobile factor is sector-specific capital. Profit maximization under perfect competition yields the traditional result that labour is paid its marginal product value. Moreover, zero profits are achieved. The immobile factor is paid a residual rent. That is,

$$\begin{aligned} R_j &= p_j y_j - w L_j = p_j y_j - p_j \frac{\partial y_j}{\partial L_j} L_j = p_j L_j \left(\frac{y_j}{L_j} - \frac{\partial y_j}{\partial L_j} \right) \\ &= p_j L_j \left(AP_{Lj} - MP_{Lj} \right) > 0 \quad , \quad L_j > 0, \ j = p, l, roe \end{aligned} \tag{2}$$

The fourth sector, the state-owned enterprises, behaves differently. By assuming that the management of the state-owned firms seeks to maximize the size of the enterprise and not its profits, it hires as many workers as possible. Hence, state capital is considered allocated free of cost from the perspective of the state-owned firm. The problem of the firm simply is to maximize revenues subject to the wage bill, which implies hiring labour at a nominal wage rate equal to the value average product of labour, $w = p_{soe} \cdot AP_{L_{soe}}$, instead of the value marginal product of labour, $p_{soe} \cdot MP_{L_{soe}}$, as is the case in the rest of the economy. Since $MP_{LL} < 0$, $AP_L > MP_L$ for any $L > 0$. As is the case in the competitive part of the economy, the residual rents of the SOE go to the immobile factor: state allocated capital. However, since capital is allocated free of cost, the rents accrued by the government are effectively zero.[3]

2.2. Households. The model considers three households. Two lower-income households in rural and urban areas, $h_1$and h_2 respectively, and a higher-income household, h_3, found both in the rural and urban areas. Household preferences for the goods consumed are represented by

[3]It is this zero-capital rent property of SOEs that motivates our choice of a specific-factor model. If we considered a Hecksher-Ohlin model with intersectoral mobility of all factors, then the zero cost of capital would extend to all sectors — clealry, an undesirable property within a general equilibrium model (it would be equivalent to having only labour as factor of production). Ghosh and Whalley (2008) consider also a specific-factor model of the Vietnamese economy.

CES utility functions

$$U_i = U_i(x_{i,j}) = \left(\sum_j \beta_{i,j} x_{i,j}^{\frac{\epsilon_i - 1}{\epsilon_i}} \right)^{\frac{\epsilon_i}{\epsilon_i - 1}}, \quad i = 1,2,3, \quad j = p,m,l,soe \tag{3}$$

where ε is the elasticity of substitution,[4] and β denotes the share parameter that determines demand patterns of the households.

The income of each of the households is given by

$$I_i = \sum_j \left(\gamma_{i,j} w L_j \right) + \sum_{j \neq soe} \left(\lambda_{i,j} R_j \right) + \theta_i G, \quad i = 1,2,3 \quad and \quad j = p,l,soe,roe \tag{4}$$

where $\gamma_{i,j}$ are household shares of labour income (with $\sum_i \sum_j \gamma_{i,j} = 1$), and $\lambda_{i,j}$ are the residual rents from immobile factors (with $\sum_i \sum_{j \neq soe} \lambda_{i,j} = 1$). Using γ and λ, the modeler assigns property rights of the total economy factor endowments to the households. G denotes total transfers to/from the government. These are described in detail when introducing the government below. θ_i denotes household share of G where $\sum_i \theta_i = 1$.

Welfare maximization subject to the income equal expenditure constraint leads to the following demand functions

$$x_{i,j} = \beta_{i,j}^{\epsilon_i} \left(\frac{p_i}{P_i} \right)^{-\epsilon_i} \frac{I_i}{P_i}, \quad i = 1,2,3 \quad \text{and} \quad j = p,m,l,soe \tag{5}$$

where $P_i = \left(\sum_j \beta_{ij}^{\epsilon_i} p_j^{1-\epsilon_i} \right)^{\frac{1}{1-\epsilon_i}}$ is the subjective CES price index.

2.3. Government. Given our small open economy assumption, world prices are kept fixed. By setting tariffs at an arbitrary level the government has full control over the domestic prices. Assuming ad valorem tariff rates, the domestic prices (p) are given by world prices (p^w) times the mark-up $(1 + t)$, where t is the percentage tax rate on imports, i.e.

$$p_j = p_j^w (1 + t_j) \tag{6}$$

The government solely focuses on managing a balanced budget. Hence, it is simply repre-

[4] For our calculations we set this elasticity at 0.8. Other values (i.e. 0.6 and 0.9) have been used without any change to our qualitative results.

sented by a budget constraint

$$G = T = \sum_j t_j p_j^w z_j + R_{soe} \tag{7}$$

where G is government expenditure, T is revenues from trade taxes and rents accrued from state-owned enterprise capital (which, as discussed above, is zero if SOE maximize revenues), and z_j being imports defined as excess demand ($z_j = \sum_i x_{i,j} - y_j$). The actions available to balance the budget are simple lump-sum taxes, i.e. either collecting a lump sum tax from the households in case of a budget deficit, or distributing a lump sum tax to the consumers in case of a budget surplus.

Finally, full employment and balanced trade conditions are imposed to clear the labour and goods markets, respectively.

Before moving to the calibration of the model using data from Vietnam, we should emphasize the importance of having state-owned enterprises (SOE) in the model. We showed that under the assumption that SOEs maximize revenues, a SOE will hire labour at a wage equal to the value of the average product instead of the value of the marginal product of labour. The SOE will thus demand more labour than is economically efficient. This higher demand will drive up the (nominal) wage and lower the potential output of the rest of the economy. In this situation, a tariff on SOE produced goods will aggravate the distortion SOEs create, as it will even further move recourses towards the state-owned sector. Reducing tariffs is naturally a correct response to this. However, as the theory of the second-best tells us, not any tariff reduction will work. That is exactly the purpose of building an applied general equilibrium and calibrating to the Vietnamese data.

3. Case Study: The Vietnamese Accession to the WTO

Using Vietnam's WTO accession as a case, we proceed by calibrating the model to the data. To do that, we need to aggregate the existing data into 3 type of households and 4 type of production sectors. Starting from production, functions are calibrated on the basis of the value added shares of each of the four sectors in the model. Consumer demands are then preset residually to match trade patterns of the Vietnamese economy. A top down split of GDP shares is shown in table 3.

The primary production sector, y_p, includes the activities agriculture, forestry and fishing which sum to 21.8% of GDP. The factor allocation in the primary sector implies a 80.7% labour

Year 2004	Total economy (p,l,roe,soe)	Non-primary sectors (l,roe,soe)	Primary sector (p)	Rest of economy (roe)	Private manufacturing (l)	State manufacturing (soe)
Labour	70.3	67.4	80.7	48.2	48.2	100
Capital	25.5	32.6	–	51.8	52.8	–
Land	4.2	–	19.3	–	–	–
GDP shares	100	78.2	21.8	38.0	11.3	28.9

Source: Nielsen (2002), General Statistics Office of Vietnam, IMF WEO, Penn World Table, and own calculations

Table 3: Model benchmark: Sectoral GDP shares and factor allocation

value added share and a 19.3% land value added share. Aggregate capital formation constitutes 25.5% of GDP. Capital is allocated in the manufacturing and service industries and comprise 32.6% of non-primary production value added. These are split on the two private sectors, y_l and y_{roe}, since the assumption of un-priced capital in state-owned enterprises implies that labour value added makes up a 100% of total factor value added going into SOE production, y_{soe}.

Recall that the value of φ_j is a product of $F_j^{1-\alpha}$ and an unobservable sector specific technology scale parameter, A_j . Given the Ricardo-Viner structure of the model, calibration of the parameters φ_i and α_i suffices. The calibrated values are shown in table 4.

	p	roe	l	soe
α_j	0.81	0.48	0.48	0.30
φ_j	1.68	8.24	4.41	8.83

Source: WTO, Comtrade and own calculations

Table 4: Supply side parameters in the Vietnam Model

Moving into the demand side of the economy, we need to match the Vietnamese reality described in the introductory section and thus consider three heterogenous households: the lower income rural population, h_1, the lower income urban population, h_2, and the higher income population, h_3, found in urban as well as rural Vietnam.

The key to distribute factor income among the three households stems from Nielsen's (2002) social accountancy matrix (SAM) found most suitable for the purpose of this analysis. From this SAM, a small sub-matrix is extracted and simplified.

The point of departure for creating the postulated income distribution is an assignment of rights of access to the factor endowments. As mentioned previously, income inequality in Vietnam is no higher than in a typical European economy. In general, inequality is low but there is an above average inequality between rural and urban Vietnam and within urban Vietnam,

while in the rural areas the average Vietnamese citizen tends to be poorer and facing almost no inequality. This view has spurred an assignment of rights of access to income accrued from unskilled, medium skilled, and skilled types of labour used in Nielsen (2002), and from land and capital. In doing that, we note that while general education in Vietnam is not high compared to developed economies, the majority of the population has a standard elementary school education and literacy levels are above 90% for both genders (UNESCO). This has led to the assumption that the lower income households receive income both from paid unskilled jobs and from (medium skill) self-employment. The lower income rural household receives 15% of land rents whereas the majority of land rents are received by the higher income household. The resulting calculations are presented in table 5.

	Agri. self-empl. earnings	Non-agri. self-empl. earnings	Paid labour earnings	Land	Capital	Total income share*
Lower income rural household	86.6	36.8	35.5	15.0		34.8
Lower income urban household	6.3	46.6	25.7			18.8
Higher income household	7.1	16.7	38.7	85.0	100	46.4
Total	100	100	100	100	100	100

Source: Nielsen (2002), GSO, IMF WEO, Penn World World Table, and own calculations

*This is the benchmark distribution in the applied model

Table 5: Sectoral income distribution in the Vietnam Model, per cent

On the basis of this income distribution, population shares are assigned[5] and per capita income measures are calculated. The results are presented in table 6.

Benchmark scenario (year 2004)	Population		GDP		GDP per capita		GDP per capita per day		
	Pct.	Mill.	Bill. Dongs	Bill. USD	Thousand Dongs	USD	Thousand Dongs	USD	USD PPP corrected[1]
Lower income rural population	58.0	47.3	248,855	15.9	5,259	336.1	14.41	0.92	4.64
Lower income urban population	20.0	16.3	134,477	8.6	8,241	526.8	22.58	1.44	7.27
Higher income population	22.0	17.9	331,974	21.2	18,494	1,182	50.67	3.24	16.31
Total	100	81.6	715,307	45.7					
Economy average					8,767	560.4	24.02	1.54	7.73

Source: Nielsen (2002), General Statistics Office Of Vietnam, Haughton et al (2006), IMF WEO, Penn World Table (2006), and own calculations

1: PPP correction is 5,035 (IMF WEO)

Table 6: Detailed income distribution based on the Vietnam Model

[5] Using a Lorenz-curve shape that matches the Vietnamese Gini-coefficient in table 2. The Lorenz-curve is inspired by an expenditure-based Lorenz-curve in Haughton et al. (2006).

Finally, in performing the evaluation of the WTO accession rules we need to know the initial level of tariffs. We take these tariffs to be the bound tariff rates that Vietnam was obliged to have in 2007 before entering WTO. These rates (together with the final rates to be implemented in 2014) are attached to the WTO document WT/ACC/VNM/48/Add.1, which is downloadable from WTO's homepage. However, since these rates are reported at a very disaggregate tariff line level — e.g. it contains 1,700-1,800 line items on agricultural products and about 13,000 items on manufacturing products, all at an 8-digit HS trade classification — we need first to aggregate them. We have used the following step procedure: (i) calculate simple tariff averages of detailed HS data to create two-digit level HS data, (ii) convert the two-digit level HS data to two-digit level SITC data (as we only have detailed trade data for this categorization),[6] (iii) calculate weighted average tariff on one-digit level SITC categories, where the weights are the trade volumes at the two-digit level SITC,[7] and (iv) convert the SITC categorization to the average tariff rates that our four sectors face using the information from the General Statistics Office of Vietnam (GSO, 2004) about ownership.[8] The result of this procedure is presented in row one (benchmark) and row two (final accession rates) of table 7 — the rest of the rows present other tariff reform scenarios examined in this paper and which are explained in detail below.

Scenarios	p	roe	l	soe
Benchmark - 2007 tariff rates	28.1	13.5	13.3	19.4
I - final accession 2014 tariff rates	22.9	11.0	8.1	15.7
II - Concertina cut	19.4	13.5	13.3	19.4
III - proportional 20 per cent cut	22.5	10.8	10.6	15.5
IV - subsidy experiment	28.1	13.5	13.3	−32.0
V - restructuring SOEs + benchmark rates	28.1	13.5	13.3	19.4
VI - restructuring SOEs + final 2014 rates	22.9	11.0	8.1	15.7
VII - restructuring SOEs + concertina cut	19.4	13.5	13.3	19.4
VIII - restructuring SOEs + proportional cut	22.5	10.8	10.6	15.5

Source: WTO, Comtrade, own calculations

Table 7: Tariff rates applied in the scenarios, per cent

3.1. The analyzed scenarios. As mentioned above, the benchmark scenario replicates the tariff structure of the Vietnamese economy at the point of entry at the WTO, i.e. in 2007. In

[6] See table A1 in the appendix for these tariff averages (both the bound 2007 and the final 2014 rates).
[7] Reported at table A2 in the appenidx.
[8] This ownership information is presented in table A3 in the appendix.

that benchmark case, the model in section 2 is used, where state-owned enterprises maximize revenues. Scenarios I-IV in table 7 are all using the same model but with different tariff rates.

Scenario I is applying the WTO accession-led tariff cuts that Vietnam has committed to implement by 2014. As we see, the most notable relative drop is within the light manufacturing sector (a 39% reduction), followed by the SOE sector (19% reduction) and the primary and ROE sector (18.5% reductions). In terms of absolute tariff reductions, the primary and the light manufacturing sector face a 5.2 percent points cuts, while the SOE face a 3.7 percent points cut and the ROE only a 2.5 percent point cut. Thus, the WTO accession-led tariff cuts reduce both the mean and the variance of the existent tariff structure. As we know from recent results in the theory of tariff reforms, such reductions are likely to be welfare enhancing in standard general equilibrium trade models (see Anderson and Neary, 2007).

Scenarios II and III focus on other tariff reforms that in conventional settings should yield welfare improvements. In scenario II we introduce a concertina cut, where the highest tariff falls to the second highest tariff level, while scenario III introduces a 20% proportional tariff cut to all tariff rates. From theory we know that such reductions will also increase welfare if goods are substitutes for each other and if normality in consumption is assured (see Hatta, 1977) – both assumptions that hold in our setting.

Scenario IV reduces the tariff on the SOE produced good leaving the other tariff rates unaltered. In this sense, it is also a univariate reform like the concertina reform, but while the concertina reform reduces the highest tariff (assuming that this is the highest distortion), here we reduce the tariff of the sector that distorts mostly the economy (both due to protection and due to the assumed revenue maximizing behavior). Thus, in essence, the present scenario is really what a concertina reform should do in our model, i.e. reduce only the highest distortion. In order to illustrate the potential gains of such a reform, we calculate the optimal tariff reduction. By using iteration techniques, the rate that maximizes the welfare gain from such a univariate reform turns out to be a 32% import subsidy.

Scenario V represents a different model and constitutes thus a different benchmark for the rest of the scenarios. We apply the initial 2007 tariff structure within a model that does not contain the assumed state-owned enterprise behavior. This scenario should capture the effects of a complete reformation of the SOEs (so that they now behave as profit maximizers and not as output maximizers) prior to the reformation of tariffs. The following 3 scenarios, VI, VII, and VIII, use this new benchmark situation and allow for tariff reforms. Scenario VI allows for the

final 2014 WTO-imposed tariff rates; scenario VII allows for a concertina cut, and scenario VIII allows for a proportional cut. Such a sequence of scenarios should capture the extra gains that we may get from external (tariff) reforms when internal (SOE) reforms are already in place.[9]

4. Results from different counterfactuals

Table 8 below presents the main results from the different scenarios.[10] We focus on production efficiency, real income and consumption, real factor rewards, and consumers' welfare change.

	Main scenarios					Competitive scenarios with scenario V as benchmark		
	I	II	III	IV	V	VI	VII	VIII
Production efficiency	99.9	99.2	100.0	107.8	109.7	100.0	100.2	100.1
Real income	100.0	99.3	100.0	101.0	109.7	100.1	100.3	100.1
Real consumption	99.9	99.2	100.0	107.8	109.7	99.8	97.8	99.5
Real wage	99.3	97.3	99.3	110.1	88.2	99.1	95.8	99.1
Rents to immobile factors	97.3	99.9	97.9	113.4	163.4	97.3	101.2	97.7
Consumer welfare change (pct.)*								
Lower income rural household	-1.2	-6.6	-1.7	+16.3	+24.3	-1.4	-7.4	-2.1
Lower income urban household	+0.7	+2.4	+0.7	-9.8	-12.3	+1.3	+5.0	+1.5
Higher income household	+0.5	+2.4	+0.9	+2.1	+7.6	+0.9	+5.2	+1.6
Consumer welfare change, total	-0.1	-0.7	0.0	+4.9	+9.7	+0.1	+0.3	+0.1

Source: The model

* Measured as equivalent variation relative to benchmark income

Table 8: Main results

[9] Before we proceed to the descrption of the results, it is important to note that in comparing the different scenarios we use different reform sizes. While the concertina brings the highest tariff down to the second highest tariff level, the proportional reform cuts all tariffs linearly by 20%, and the WTO accession reform cuts tariffs nonlinearly by an average of 26.3%. In scenario IV, we find the optimal size of the SOE tariff in terms of maximizing welfare gains. Thus, all our scenarios choose different sizes of tariff reductions; a property that in many ways is not ideal if we wanted to compare the welfare effects, e.g. which reform gives the highest welfare increase. A better approach would be to set all scenarios at an equal footing (e.g. by requiring that they deliver the same revenues, or by requiring that they are of the same size) and then see which one performs best (see Raimondos-Møller and Woodland, 2011). Here we stick to the conventional approach of pre-defining different reform sizes and examining only the sign of the effects (and not the size of the effects).

[10] More detailed tables are presented in appendix 2.

4.1. Scenarios I - IV: tariff reforms under a distorted SOE sector. The assessment of economy-wide efficiency shows that the implementation of the final WTO tariffs (scenario I) is not overall beneficiary to Vietnam, nor is it beneficiary for the income inequality that exists in the country. In fact, the lower income rural population will face a money metric welfare loss of 1.2% of their income, while the richer households will gain by 0.5%. The reason for this may be assessed both from the supply side and the demand side of the economy.

On the supply side, the change in the tariff scheme is relatively soft on SOE production, implying that the sector stays relatively protected and still demands an excessive amount of labour. According to our calculations (see table A7 in the appendix for detailed sector results) the SOE production consumes 41.4% — up from 41% in the benchmark scenario — of the effective labour supply. The labour demand effects in the rest of the sectors skew the relative labour demand toward private and government services and other activities (L_{roe}) at the expense of the primary sector (L_p) and the privately manufactured goods sector (L_l).

Since the primary sector production is more sensitive to changes in the size of the labour supply, production drops significantly (see table A4). With consumer demand for primary goods hardly affected, the production fall will reduce the exports of the primary sector (see table A5). Reduction of exports will reduce the overall Vietnamese purchasing power, per se, and thus the real consumption overall falls. When the lower income rural population suffers the most, it is due to its high dependency on the primary sector. The fall in the effective labour supply in the primary sector and the fall in rents to the immobile factor jointly produce the largest relative decline in real income among the three income groups. It suffers a 1.2% real income loss while the overall loss for the whole population is only 0.1%.

As we discussed previously, the WTO accession-led reform reduces both the simple mean and variance of the benchmark tariff structure. Even if these are desirable properties of a tariff reform, we do not know with certainty whether this particular reform was put wrongly together.[11] Other, more standard, reform rules should be examined. Within the theory of piecemeal reforms, two rules are standard; the concertina rule and the proportional rule. Both rules are known to provide welfare gains under very general assumptions. However, with a state-owned sector distorting resource allocation, such welfare improvements may not arise.

As seen in column II, table 8, performing a concertina cut will worsen welfare in our model.

[11] It does not follow the (often used by WTO) Swiss rule, where all tariffs fall and with the highest tariffs falling mostly.

The reason is simply the following: lowering the highest tariff (primary products) implies increasing relative protection for the SOE producers. Thus, instead of reducing the biggest distortion in the economy, this reform will increase it. This will happen at the expense of especially the primary sector and thus the labour employed in that sector, which to a large extent is the lower-income rural population. While the welfare of the urban population will rise, this rise is not enough to neutralize the loss of the rural households. A proportional cut (column III, table 8) will again not generate gains since lowering all tariffs rates proportionally will bring the primary good tariff level closer to the SOE tariff level. Thus the SOE sector is again, as in scenarios I and II, protected at the expense of especially the primary sector. Still, and compared to a concertina cut, the SOE sector's protection is relatively reduced. In our simulation example, not significant changes will occur in aggregate real income, production efficiency, and in general agregate welfare. However, income inequality will definitely increase with the lower income households loosing out again. Both these two scenarios underline the consequences of underestimating the presence of a special SOE behavior and thus falsely suggesting concertina or proportional cuts in the search for welfare gains.

In scenario IV we return to the univariate type of reforms where only one tariff is reduced. However, now we choose a different tariff than the highest one. Let us explain. When tariffs are the only distortions in a model, reducing the highest tariff is usually equivalent to reducing the biggest distortion. However, when other distortions are in place, the highest tariff may not be equivalent with the biggest distortion. In the present model the sector that distorts mostly the efficient allocation of resources is the sector with state-owned enterprises. Even if that sector does not face the highest tariff protection, it is that sector's tariff that should be reduced. Leaving thus all the other tariffs unaltered, scenario IV allows the tariff of the SOE sector to fall.[12]

The next question then is how much to reduce that tariff.[13] In what follows we use iteration techniques and perform a numerical search for the locally optimal SOE tariff, i.e. a SOE tariff that maximizes the aggregate welfare gain given that the other tariffs do not change. As can be read from table 7, this optimal tariff turns out to be negative, i.e. an import subsidy, and equal to 32%. By subsidizing the imports of the goods produced by the state-owned enterprises, the

[12] Note that an alternative reform would be not to constrain the direction of the tariff reform, and thus to allow raising the protection in other sectors. However, since such reforms can not be part of a WTO-based reform, we abstract from such reforms in this paper.

[13] Since tariff levels do not provide much information in this setting, we can not follow the "down to the second highest tariff level"-type of rule.

aggregate welfare will rise by 4.9% with the poor rural households benefiting the most and thus reducing inequality (see column IV, table 8). The mechanisms for such results are based on the fact that the effective supply of labour to the state-owned sector will drop to 20.8% (down from 41.2%), leaving labour to be re-allocated to other sectors where its use is more efficient. As a result of this, the primary sector ends up increasing its exports. In general, trade as part of the country's GDP increases considerably (see table A5 in the appendix).

In general what such a reform shows is that the ingredient that is necessary to be included in a welfare increasing tariff reform is a large and disproportionate reduction of the tariff faced by the SOE sector. This sector has been attracting too many recourses, and as long as this sector is not reformed fundamentally, one should subsidize the imports of the goods produced by the state-owned enterprises. This will reduce the domestic production of these goods and move the freed-up inputs towards other sectors where they can be better used.

4.2. Scenarios V-VIII: tariff reforms under a competitive SOE sector. We now move to a different situation, where tariff reforms are performed *after* reforming the SOE sector into a competitive sector. Clearly, in that situation the rental rate of capital in the SOE sector will not be zero anymore. Firms in that sector will now have an incentive to choose a more balanced use of capital and labour, and capital rents will be distributed back to households. To create a new benchmark for analysing tariff liberalisation, we first allow for such internal reforms when no external reforms are put into place (the initial tariff rates are still in place); this is the situation depicted in scenario V.[14] As it is easy to see from table 8, internal reforms result in large gains in all accounts; an overall welfare increase by 9.7%;a reduction of income inequality with the lower income households experiencing a large 24.3% increase in their income; a 9.7% increase in production efficiency, real income, and real consumption. All that while wages fall across all sectors and income from rents to imobile factors increases by 63.4%.

As we have discussed above, the non-competitive nature of the SOE sector is the largest distortion in the Vietnamese economy and reforning that sector creates large overall gains. An economy wide efficiency improvement of 9.7% compared to the benchmark level is unleashed through a migration of effective labour resources to the primary sector (see table 7 in the appendix). This underlines that SOEs first and foremost attract labour resources from the sector with the most labour intensive production. The primary sector is also the main employment

[14] Note, however, the caveat mentioned in footnote 8.

sector of the Vietnamese economy, employing some 58% of the working population. Hence, it is no surprise that the lower-income rural Vietnamese population is the big winner of an SOE reform. An increase in real income of 24.3% (table A9, appendix) to the lower-income rural population brings the average GDP per capita per day from 0.90 dollars to 1.11 dollars. The lower-income urban population stands to lose considerably from the restructuring since an important income source, SOE employment, is downsized dramatically. However, the money-metric welfare gains accrued to the two other population groups by far exceeds the loss of the lower-income urban population. Thus, by redistributing ex post, Pareto improvement is attainable.

The surge in economic activity in the exporting primary sector improves the purchasing power of the Vietnamese economy, adding to the welfare gains. This is also the essence of the gains from trade: optimal production induces trade patterns that improve consumer welfare by exporting goods of the sector in which the country is relatively more competitive, and importing what is relatively unfavorable to produce domestically.

If now, on top of these internal reforms, we allow tariff reductions then there will be extra gains to the economy. However, these gains are now marginal and of the order one would expect in standard competitive setups. As seen in collumns VI-VII of table 8, a WTO-imposed tariff reduction will lead to an extra overall welfare gain of 0.1%, while a concertina and a proportional refrom will increase welfare by 0.3% and 0.1% respectively, compared to the benchmark situation described in collumn V. While the concertina and the proportional cuts were expected to give welfare gains (proven in theory), the fact that the WTO-accession tariff cuts also give comparable welfare gains is reassuring.[15]

5. Concluding remarks

Developing countries, especially socialist oriented developing countries, highly rely on state production. Indeed, Vietnam relies heavily on state industrial production. Such a predominant position of state-owned enterprises needs special consideration or otherwise mistaken policy conclusions can be made. The policy that this paper considers is the trade liberalization scheme that WTO has imposed on Vietnam upon its accession into the WTO in 2007. Tariffs have to fall in a pre-defined way by 2014. As we show, the ultimate gains from trade liberalization on economic development in Vietnam will be greatly at stake due to the distortions created by the

[15] The size of these welfare effects are specific to the simulations performed here and have no generalization power — see footnote 9 above.

strong presence of state-owned enterprises.

In the model it is assumed that the management in a state-owned enterprise pursues maximization of revenues instead of profits. Such behavior induces over-hiring of labour, attracting extra labour resources from the competitive sectors of the economy. Trade policy should take this into account and design tariffs in order to correct this over-production.[16]

The WTO accession-led tariff reform does not take all this into account. Tariffs on state-owned produced goods fall, but not a lot — other sectors' tariffs fall even more. As a result, the WTO accession tariff cuts will worsen the situation for Vietnam with the state-owned sector expanding even more. There are also distributional consequences to be aware of. Our results show that the aggregate welfare loss will hit mostly the lower-income rural population. These are the people that work in the sensitive labour-intensive primary sector. As generally recognized, this rural population is the prime source of poverty in developing countries, so the fact that the welfare losses are primarily within the lower end of the income scale demands special attention.

Policy makers must recognize that state-owned produced goods have to undergo relatively larger trade liberalization than competitively produced goods to secure the gains from trade. Therefore, not even other traditional tariff reforms (such as proportional tariff cuts and concertina cuts) will work in this setting. Such reforms will fail to reduce sufficiently the protection of the state-owned sector and thus bound to fail. Indeed, our calculations show that this is clearly the case.

Inspired by the basic principle behind the concertina tariff cut reform, viz. that we should reduce the highest distortion, we suggest a tariff reform that targets the highest distortion in the present model. We reduce the tariff of the state-owned enterprises leaving the other tariffs unchanged. To show the potential that such a reform can have, we search for the tariff level that will maximize the potential welfare gains. It turns out that the imports of the state-owned produced good should be subsidized by 32%. In that case, both the aggregate welfare and the welfare of the low income rural population will rise considerably.

Clearly, if Vietnam was able to complete within the accession period a reform of state-owned enterprises so that they become competitive, the WTO accession schedule of final rates, as all other conventional tariff reforms, will yield aggregate welfare gains. However, such a complete restructuring of the state-owned enterprises is far from what is going on in reality.

[16] The optimal tariff levels for such a small open economy are clearly not zero.

Appendix 1: Additional data

per cent	rates	
SITC Group	Bound	Final
01 Meat and meat preparations	30,0	16,6
02 Dairy products and birds' eggs	23,5	19,5
03 Fish (not marine mammals), crustaceans, molluscs and aquatic invertebrates, and preparations thereof	31,1	20,1
04 Cereals and cereal preparations	28,5	23,7
05 Vegetables and fruit	29,1	24,1
06 Sugars, sugar preparations and honey	36,2	31,5
07 Coffee, tea, cocoa, spices, and manufactures thereof	29,4	23,7
08 Feeding stuff for animals (not including unmilled cereals)	8,0	5,0
09 Misc. edible products etc	31,5	22,8
11 Beverages	60,7	45,4
12 Tobacco and tobacco manufactures	109,6	99,6
21 Hides, skins and furskins, raw	5,0	2,4
22 Oil-seeds and oleaginous fruits	10,5	8,3
23 Crude rubber (including synthetic and reclaimed)	6,0	4,8
24 Cork and wood	0,5	0,5
25 Pulp and waste paper	1,4	1,1
26 Textile fibres (other than wool tops and other combed wool) and their wastes (not manufactured into yarn or fabric)	12,4	5,8
27 Crude fertilizers, other than those of Division 56, and crude minerals (excluding coal, petroleum and precious stones)	6,7	6,7
28 Metalliferous ore, scrap	2,2	2,2
29 Crude animal and vegetable materials, n.e.s.	5,3	4,5
33 Petroleum, petroleum products and related mat	23,3	23,2
34 Gas, natural and manufactured	4,5	4,5
74 General industrial machinery and equipment, n.e.s., and machine parts, n.e.s.	10,5	8,3
75 Office machines and automatic data-processing machines	7,4	1,5
76 Telecommunications and sound-recording and reproducing apparatus and equipment	17,8	11,0
77 Electrical machinery, apparatus and appliances, n.e.s., and electrical parts thereof (including non-electrical counterparts, n.e.s., of electrical household-type equipment)	12,4	9,2
78 Road vehicles (including air-cushion vehicles)	55,8	41,6
79 Other transport equipment	7,1	5,8
81 Prefabricated buildings sanitary, plumbing, heating and lighting fixtures and fittings, n.e.s.	20,2	15,5
83 Travel goods, handbags and similar containers	39,1	25,0
84 Articles of apparel and clothing accessories	21,2	19,5
85 Footwear	35,6	27,1
87 Professional, scientific and controlling instruments and apparatus, n.e.s.	2,4	1,3
88 Photographic apparatus, equipment and supplies and optical goods, n.e.s. watches and clocks	12,6	8,6
89 Miscellaneous manufactured articles, n.e.s.	20,4	15,0
93 Special transactions and commodities not classified according to kind	0,0	0,0
97 Gold, non-monetary (excluding gold ores and concentrates)	1,5	1,5

Table A1: Average tariff rates, 2-digit SITC categories: 00-20, and 30-90

	rates (%)	
SITC Group	Bound 2007 rates	Final 2014 rates
0 Food, foodstuff and live animals	21.5	16.6
1 Beverages and tobacco	103.4	92.7
2 Crude materials, inedible, except fuels	5.8	3.7
3 Mineral fuels, lubricants and related materials	22.6	22.6
4 Animal and vegetable oils, fats and wax	17.0	14.3
5 Chemical and related products, n.e.s.	13.0	6.5
6 Manufactured goods classified chiefly by materials	15.1	12.2
7 Machinery, transport and equipment	22.2	16.1
8 Miscellaneous manufactured articles	20.0	15.7
9 Other	1.5	1.5

Source: Comtrade, WTO and own calculations

Table A2: Average tariff rates, 1-digit SITC categories

By kind of economic activity	GDP Share	Vietnam Model Sector	Ownership
Agriculture	16,7	Primary	Private
Forestry	1,3	Primary	Private
Fishing	3,8	Primary	Private
Mining and quarrying	10,1	SOE	State
Manufacturing	20,3	SOE/Private	State/Private
Electricity, gas and water supply	3,5	SOE/Private	State/Private
Construction	6,2	SOE/Private	State/Private
Wholesale and retail trade; repair of motor vehicles, motor cycles and personal and household goods	13,6	ROE	Private
Hotels and restaurants	3,2	ROE	Private
Transport, storage and communications	4,3	ROE	Private
Financial intermedation	1,8	ROE	State
Scientific activities and technology	0,6	ROE	State
Real estate, renting and business activities	4,4	ROE	Private
Public administration and defence; compulsory social security	2,7	ROE	State
Education and training	3,3	ROE	State
Health and social work	1,5	ROE	State
Recreational, cultural and sporting activities	0,5	ROE	Private
Activities of party and of membership organisations	0,1	ROE	State
Community, social and personal service activities	2,0	ROE	State
Private households with employed persons	0,2	ROE	Private

Source: GSO (2004)

Table A3: Sector allocation in the model

Appendix 2: Detailed results from simulations

benchmark = index 100	Bencmark	I	II	III	IV	V	VI	VII	VIII
Primary sector	100.0	97.7	85.8	96.6	143.6	169.4	98.5	91.6	97.7
Priv. and gov. services, and other activities	100.0	101.2	103.2	101.2	108.4	112.4	101.4	104.7	101.4
Private manufacturing	100.0	98.9	103.2	101.2	108.4	112.4	99.1	104.7	101.5
State manufacturing	100.0	100.2	101.5	100.2	81.5	63.0	100.3	102.1	100.3
Total economy	100.0	99.9	99.2	100.0	107.8	109.7	100.0	100.2	100.1

Source: The Vietnam model
Scenarios VI-VIII are relative to scenario V.

Table A4: Production efficiency

per cent	Benchmark	I	II	III	IV	V	VI	VII	VIII
Primary sector	-9.2	-8.5	-5.2	-8.1	-20.5	-20.9	-20.1	-16.5	-19.7
Priv. and gov. services, and other activities	5.4	4.9	3.8	5.0	-1.7	4.6	4.1	2.8	4.1
Private manufacturing	-6.6	-6.3	-7.1	-6.8	-8.2	-6.8	-6.6	-7.5	-7.1
State manufacturing	7.5	7.8	6.8	7.8	25.0	17.8	18.4	17.6	18.4

Source: The Vietnam model

Table A5: Net trade (% of GDP)

benchmark = index 100	Bencmark	I	II	III	IV	V	VI	VII	VIII
Primary sector	100	93.8	80.0	92.4	143.6	169.4	94.6	85.4	93.4
Priv. and gov. services, and other activities	100	98.9	103.2	98.8	108.4	112.4	99.1	104.7	99.0
Private manufacturing	100	94.4	103.2	98.8	108.4	112.4	94.6	104.7	99.1
State manufacturing									
Total economy	100	97.3	99.9	97.9	113.4	163.4	97.3	101.2	97.7

Source: The Vietnam model
Scenarios VI-VIII are relative to scenario V.

Table A6: Rents to immobile factors

Per cent	Benchmark	I	II	III	IV	V	VI	VII	VIII
Primary sector	25.1	24.3	20.7	24.0	39.2	48.1	47.3	43.2	46.7
Priv. and gov. services, and other activities	26.0	26.7	27.8	26.7	30.8	33.2	34.2	36.5	34.2
Private manufacturing	7.7	7.6	8.3	7.9	9.1	9.9	9.7	10.9	10.2
State manufacturing	41.2	41.4	43.2	41.4	20.8	8.8	8.9	9.5	8.9

Source: Vietnam Model
Note: Percentage share of the total effective labour force

Table A7: Effective labour supply

	Real wage	Scenario wage levels (benchmark = index 100)							
	Benchmark	I	II	III	IV	V	VI	VII	VIII
Lower income rural household	0.85	99.3	97.3	99.3	110.1	88.2	99.1	95.8	99.1
Lower income urban household	0.85	99.4	97.2	99.3	110.0	88.2	99.1	95.7	99.0
Higher income household	0.85	99.5	98.0	99.5	107.1	88.2	99.3	96.4	99.2

Source: The Vietnam model
Note: The model operates with a single nominal wage rate meausered per effective labour unit. Real wage rates are based on expenditure weighted priceindices according to household consumption spending compositions. Scenarios VI-VIII are relative to scenario V.

Table A8: Real wage by household

per cent	I	II	III	IV	V	VI	VII	VIII
Lower income rural household	-1.1	-6.6	-1.6	+12.0	+24.3	-1.0	-5.6	-1.6
Lower income urban household	+0.7	+2.5	+0.8	-13.1	-12.3	+1.1	+4.2	+1.2
Higher income household	+0.5	+2.5	+1.0	-1.6	+7.6	+0.7	+4.1	+1.3
Total	0.0	-0.7	0.0	+1.0	+9.7	+0.1	+0.3	+0.1

Source: The Vietnam model
Note: Real income is measured as household nominal income deflated by an expenditure weighted price index specific to each household. Scenarios VI-VIII are relative to scenario V.

Table A9: Real income changes

benchmark = index 100	Bencmark	I	II	III	IV	V	VI	VII	VIII
Primary sector	100	101.0	105.2	101.5	88.6	109.3	101.2	106.5	101.6
Priv. and gov. services, and other activities	100	99.4	98.4	99.5	88.9	109.9	99.5	99.3	99.6
Private manufacturing	100	101.5	99.3	99.7	87.9	108.1	101.6	100.4	99.8
State manufacturing	100	100.1	98.4	100.2	139.5	109.9	100.2	99.3	100.3
Total economy	100	99.9	99.2	100.0	107.8	109.7	101.6	109.1	102.4

Source: The Vietnam model
Scenarios VI-VIII are relative to scenario V.

Table 10: Real consumption changes by sector

benchmark = index 100	Bencmark	I	II	III	IV	V	VI	VII	VIII
Lower income rural household	100	98.8	93.3	98.3	119.5	124.3	99.0	94.4	98.4
Lower income urban household	100	100.7	102.4	100.7	92.7	87.7	99.0	94.4	98.4
Higher income household	100	100.5	102.3	100.9	105.0	107.6	99.8	97.3	99.4
Total economy	100	99.9	99.2	100.0	107.8	109.7	99.8	97.8	99.5

Source: The Vietnam model
Scenarios VI-VIII are relative to scenario V.

Table A11: Real consumption changes by household

Appendix 3: Data sources

Our main sources of data are the following:

- Comtrade, United Nations Commodity Trade Statistics Database, at
  - http://unstats.un.org/unsd/comtrade/.
- European Commission:
  - Trade issues: http://ec.europa.eu/trade/issues/newround/index_en.htm
  - GSP 2003: http://ec.europa.eu/trade/issues/global/gsp/gspguide.htm
  - External relations: http://ec.europa.eu/external_relations/index.htm
  - External relations with Vietnam:
    - http://ec.europa.eu/external_relations/vietnam/intro/index.htm
- GSO, General Statistics Office of Vietnam, http://www.gso.gov.vn/
- IMF, 2006, various online information incl. statistics. WEO: World Economic Outlook Database.
- Heston, A., R. Summers, and B. Aten, 2006, Penn World Table Version 6.2, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania.
- World Bank, 2007, World Development Indicators database,
  - http://siteresources.worldbank.org/DATASTATISTICS/Resources/GDP.pdf.
- WTO, World Trade Organisation, various online information incl. statistics:
  - http://www.wto.org/english/thewto_e/whatis_e/tif_e/fact4_e.htm
  - and http://www.wto.org/english/tratop_e/schedules_e/goods_schedules_e.htm
  - http://www.wto.org/WT/ACC/VNM/48/Add.1

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Chapter 2

Import, Offshoring and Wages: Rent Sharing or Composition?

BY

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Abstract: Offshoring firms are found to pay higher average wages than purely domestic firms. We provide a unifying empirical approach by capturing the different channels through which offshoring may explain this wage difference: (i) due to change in the composition of workers (skill composition effect) (ii) because all existing workers get higher pay (rent sharing effect). Using Danish worker-firm data we explain how much each channel contributes to higher wages. To estimate the causal effect of offshoring on wages we use China's accession to the WTO in December 2001— and the soon after boom in Chinese exports —as positive exogenous shocks to the incentive to offshore to China. Both skill composition and rent sharing effects are found to be important in explaining the resultant gain in wages. We also show that the firm's timing in the offshoring process determines the relative importance of a channel. For firms offshoring to China in 2002 but not in 1999, only rent sharing explains the gain in wages. For firms offshoring to China both before and after China's WTO accession the wage increase is explained mostly by the skill composition effect. Moreover, these patterns are not discernible from the measures of skill composition and rent sharing available in typical firm level datasets – like ratio of educated to uneducated workers and sales per employee.

JEL Codes: F16, F12
Keywords: Offshoring, wages, rent sharing, China, WTO, worker-firm-panel

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Acknowledgments: Thanks to Pascalis Raimondos-Møller, Donald Davis, Amit Khandelwal, Eric Verhoogen, Nikolai Malchow-Møller, Jonathan Vogel, David Weinstein, and participants of Columbia Trade Colloquium, Princeton EconCon Conference, ETSG Conference 2010, Asian Diversity in a Global Context (Globalization and trade), CBS/SDU PHD workshops for helpful comments and suggestions. Madhura gratefully acknowledges financial support from Program for Economic Research and the Graduate School of Arts and Sciences at Columbia University. Henrik gratefully acknowledges Columbia University hospitality, and the financial support for the stay from Otto Mønsteds Fond, Augustinus Fonden, Knud Højgaards Fond, Reinholdt W. Jorck og Hustrus Fond, and The Danish Research Counsil (FSE).

1. Introduction

One of the pertinent questions regarding globalization is: how does globalization affect wages? In this paper we address a particular aspect of that question: how does offshoring[1] affect firm level average wage? Offshoring firms are found to pay higher average wages than purely domestic firms (Bernard et al 2007). Guided by existing theory, we provide empirical analyses of different possible channels through which offshoring can cause firm average wage differentials. Offshoring may push up firm level average wage in different ways: first, if firms offshore low-skilled low-wage tasks that automatically increases the average wage of the remaining jobs. We call this the skill composition effect. Second, offshoring can be viewed as new technology that firms adopt to reduce costs and increase revenue and profits. In a labor market environment featuring search, screening and bargaining frictions, offshoring firms and their workers bargain over firm specific rents— offshoring induced rents can increase wages of all existing workers and thus increase average wages in these offshoring firms. We call this the rent sharing effect.

We explain how much each effect contributes towards higher average wages in offshoring firms. Papers in the offshoring literature look at one channel at a time but not both. It is possible that both effects exist in the data and looking at one channel by ignoring the other may confound the results. In the past few years offshoring has become a major trading activity. The impact of offshoring on parent country labor outcomes stirs public controversy. We carefully investigate Danish worker-firm data to disentangle the effects of the two suggested mechanisms on firm average wages. It is important to distinguish the two effects from one another as policy makers would draw diametrically opposite conclusions from either effect. While we document the presence of the skill composition effect, underlining that certain jobs in Danish firms do move out of the country, we also document that Danish firms benefit from increased profitability and share this increased profitability with workers, i.e. through rent sharing. Thus the presence of the one channel, skill composition, highlights what developed nations worry about, but there is also the rent sharing channel that tells a positive story about offshoring, and for some firms we find that the latter channel completely accounts for the differential wage gains from offshoring.

Identifying the causal relationship between offshoring and higher firm level average wage is difficult. First, firms endogenously select into offshoring: firms that offshore are, on average, larger, more productive, and tend to pay higher wages than smaller firms that are less productive

[1] Offshoring here refers to a fragmentation of the production process due to relocation of jobs from the home country to the foreign country.

and less likely to offshore. Second, higher skilled workers may select into offshoring firms because these firms are bigger and pay higher wages. Thus, separating the causal story from the selection story is important, i.e. to say whether the higher average wage paid in offshoring firms stems from offshoring per se or from higher productivity that simultaneously leads to more offshoring, higher output, and wages.

We use Danish worker-firm data that tracks the universe of Danish workers across the universe of Danish firms. This amazingly rich dataset provides detailed information on individual wage histories from which we are able to construct measures of skill composition effect and rent sharing effect at the firm level. Following Abowd, Kramarz, and Margolis (1999) (henceforth AKM), and Frias, Kaplan, and Verhoogen (2012),[2] we decompose the firm level average wage in each year into an average person component, reflecting the skill composition of the workforce, and a firm component which we interpret as the measure of time-varying firm specific rent sharing.

We use events in China to identify the causal effect of a change in the incentive to offshoring on firm level average wages. We argue that two possibly related events occurred: First, China's accession to the World Trade Organization (WTO) in December 2001 created a surge in foreign firms operating in China as well as new Chinese exporters. Upon accession, China made enormous changes to meet its WTO obligations including among other things restructuring industries, publishing previously internal laws and regulations, establishing formal procedures to adjudicate disputes, leveling the playing field for foreign firms, and giving all firms right to trade. These changes were phased in gradually over a transition period, usually within three years after accession, directly influencing firms' incentive to offshore to China. Second, there was a boom in Chinese world exports around 2003 driven by the structural changes undertaken by the Chinese government around that time. This led Chinese exports to more than double from 400 billion US dollars in 2002 to 900 billion in 2005. The surge in Chinese exports acted as an additional indirect incentive for firms in Denmark to source from China in order to maintain competitiveness with firms who would have cost advantage by sourcing cheaper Chinese resources. Thus, China's joining the WTO can be viewed as a shock to the trading environment in China and the observed Chinese export boom as a cost/technology shock, to which we expect Danish firms to respond. In fact, we do see a jump in the Danish share of imports from China in 2003, indicating that Danish firms were affected by the shock.

[2] For an extended and more detailed version, see Frias, Kaplan, and Verhoogen (2011).

The first step of our analyses is to ensure that within industries, firms offshoring to China were affected differently compared to firms who were not offshoring to China in the 2002-2005 period.[3] Next we check that the differential change was greater during the shock period, 2002 -2005, compared to an earlier period, 1999 -2001. This procedure ensures that we are identifying trend differentials between two completely different periods and thus not trend differentials, a priori, between two types of firms – the treatment and the control group.

We find that, between 2002-2005 average wage increased around 1.5 percent more in firms offshoring to China compared to the control group. The skill composition effect accounted for a quarter of the differential increase while the rest was explained by rent sharing. Our results are robust to controlling for underlying trend differences i.e. comparing the wage gain in 2002-2005 with an earlier period, 1999-2001. Splitting firms up by their offshoring status in China we find heterogeneous results: The differential wage increase between the two periods was the largest for the new offshorers i.e. firms offshoring to China in 2002[4] but not in 1999[5] and was explained by rent sharing only. The continuing offshorers i.e. firms that offshored to China in both 1999 and 2002 experienced differential wage increase between the two periods mostly through the skill composition effect. Firms offshoring to China in 1999 but not in 2002 showed no differential wage change in this period. These heterogeneous patterns are not discernable when we use common proxies for measures of skill composition and rent sharing available in the typical firm level datasets.[6] The difference in results when using measures of composition and rent sharing effects from the firm level data to those constructed from the worker-firm data shows that we should draw results from the typical firm level data (commonly used in the offshoring literature) with more caution.

In addition to papers that use linked worker-firm and firm level data our work is related to a number of papers using industry level data. Feenstra and Hanson (1996, 1997) show that offshoring affects firm level average wage by affecting the skill composition of the domestic workforce. Becker, Ekholm & Muendler (2009) find evidence that offshoring is associated with a shift towards more non-routine and interactive tasks as well as a shift towards more educated workers (skill composition effect) in German MNEs. In these models the labor market is assumed to be perfectly competitive and cannot account for possible rent sharing effects. Allowing for

[3] In particular the control group used in the results presented in this paper includes firms offshoring to other low middle-income countries but not China in 2002 and non-offshoring firms.

[4] i.e. the beginning of the defined shock period.

[5] i.e. the beginning of the defined pre-shock period.

[6] Such as ratio of educated to uneducated workers and sales per employee.

imperfectly competitive labor market, Bagger, Christensen & Mortensen (2010) find evidence of rent sharing in the Danish labor market, but their paper does not address the offshoring issue. Sethupathy's (2008) bargaining model assumes homogeneous labor and shows that offshoring increases productivity and profitability of offshoring firms compared to non-offshoring firms. The differential increases lead to higher domestic wages at offshoring firms through a positive rent sharing mechanism. Using US MNE firm level data he provides evidence that higher average wages at offshoring firms is consistent with a rent sharing mechanism. However, his outcome is also consistent with the skill composition effect and his results do indicate that the skill composition effect is present. Kramarz (2008) also uses a bargaining model to show that offshoring can affect wages directly by altering firms' threat point and thus changing the overall quasi-rent shared between firms and workers. His model shows that level of union strength matters, with firms facing stronger unions offshore more, decreasing the size of the quasi-rent to discipline workers. Using French worker-firm data he shows that firms facing stronger unions increased offshoring more with an associated decline in employment and rents. His results indicate that offshoring might have a dampening effect on wages through the rent sharing mechanism. His paper also assumes homogeneous labor and is silent about the skill composition channel.

Our data has rich information on worker types and jobs performed and would be able to address rent sharing and the composition effect simultaneously. Hummels et. al. (2010) analyze the relationship between offshoring and workers' wages and employment opportunities also using Danish employer-employee data. They find that exogenous import shocks increase wages of skilled labors and decrease wages of unskilled workers, whereas shocks to exporting increases wages of both types of workers. Our results complement their findings on wages and shocks to offshoring; we show that offshoring affects average wages through both skill composition and rent sharing effects, and how much each of the two channels contribute relative to each other. A paper close to ours in terms of econometric methodology is Frias, Kaplan & Verhoogen (FKV 2012),[7] and, in addition, we use their method for constructing measures of firm level skill composition and rent sharing effect from the worker level data.

The paper proceeds as follows. In section 2 we discuss the theoretical motivation behind our work. Section 3 describes the dataset. Section 4 discusses the econometric methodology and identification strategy. In section 5.1 we use firm level measures similar to what has been used in the offshoring literature in the absence of worker-firm data. In section 5.2 we make full use

[7] For an extended and more detailed version, see Frias, Kaplan, and Verhoogen (2011).

of the worker-firm data to decompose firm level average wage into a skill component and a rent sharing component and analyze how a shock in the incentive to offshoring affects average wages through these channels. Section 6 does robustness checks and section 7 concludes.

2. Theoretical Motivation

In this section we briefly sketch the theoretical motivation behind our work. Suppose there are heterogeneous firms who differ in terms of productivity; heterogeneous workers who vary at the skill level; imperfections in the labor market with presence of search costs, screening and wage bargaining leading to rent sharing between firms and workers. As a result, wage of each worker type depends on the share of firm-specific rents. We do not assume any particular form of rent sharing—i.e. the form can be profit sharing, revenue sharing or both.[8] Both high skilled and low skilled tasks are required for production of a good. Either type of task can be offshored which involves a marginal cost and a common fixed cost. Heterogeneous firms and fixed cost of offshoring imply that only the most productive firms can endogenously select into offshoring. The less productive firms must source from the home market.

A new offshoring opportunity can be viewed as new technology involving a fixed cost and a lower marginal cost compared to sourcing from the home market. Following a fall in the cost of offshoring, more firms will be able to take advantage of this technology but some firms will still not be productive enough to overcome the fixed cost. The new offshoring opportunity will imply displacement of jobs in firms that offshore. Thus, a fall in the cost of offshoring changes the skill composition in the offshoring firms compared to the non-offshoring firms. If relatively low skilled, low wage jobs are sent abroad then onshore skill composition increases. Because skilled labor earns higher wage, offshoring increases the average onshore wage through a pure composition effect. This effect was first suggested in Feenstra and Hanson (1996). We call this the skill composition effect on firm level average wage.[9]

We expect that firms become more cost efficient by taking advantage of new offshoring opportunities. This effect leads to a reallocation of production and profits towards the offshoring firms. If rent sharing exists between firms and workers then the wage of the average worker increases in offshoring firms and falls in the disadvantaged, non-offshoring firms. We call the

[8] Some commonly used, empirical proxies of firm specific rents are: sales per employee (revenue) or profits per employee (profit sharing).

[9] This effect works both ways for the skill composition: If high-skill jobs are offshored the skill composition falls onshore causing the average onshore wage to fall. Recent empirical evidence suggests that offshorability does not solely depend on the skill level of the task but rather on the degree of routineness and inter-activeness of the task. So offshoring can indeed decrease the onshore skill composition.

second effect the rent sharing effect. Thus both the skill composition and the rent sharing effects could be responsible for higher domestic wages at offshoring firms compared to non-offshoring firms. Our empirical approach in sections 4.2 and 5.2 investigates how much each channel contributes towards higher average wage in offshoring firms. While the skill composition effect provides evidence for the type of jobs offshored within firms, the rent sharing effect is evidence for the firms' profitability and their survival in the market. It is important to distinguish between the two effects, since these two effects will have different policy implications .

For a simple illustration of the two effects at work, let us consider the very simple case of two types of labor: low skilled (L) and high skilled (H) labor. Onshore firm level average wage $\bar{w}$ can be expressed as:

$$\bar{w} = \sum_{f=L,H} s_f w_f \ , \ f = \{L, H\}$$

where s_f is onshore skill type share and w_f is onshore skill type wage. We can decompose the discrete change in firm level average wage that we observe in the data as

$$\Delta\bar{w} = \sum_{f=L,H} w_f \Delta s_f + \sum_{f=L,H} s_f \Delta w_f \tag{1}$$

The first term on the right hand side is the change in firm level average wage due to a change in skill composition and the second term is the change in average wage brought about through a change in the wage of each type of worker, e.g. due to a rent sharing mechanism.

Many settings can lead to simultaneous increase of revenues and profits with wages. We suggest a causal explanation by using a shock in the incentive to offshore and splitting up the effect on firm average wages into two channels: 1) skill composition change that affects firm average wage and 2) changes in profits that are shared through rent bargaining leading to all wages increasing at the firm and thus also firm average wages.

Other possible explanations include that more productive firms induce higher learning and thus higher wages. Offshoring firms may transfer knowledge across the border and increase worker productivity locally, making their workers—otherwise identical to workers in lower productivity firms—more valuable and thus pay them higher wages (Malchow-Møller, Markusen & Schjerning, 2007). We believe that this possible explanation is not a likely concern in our setting: It is not obvious that sourcing from China generates these types of spill-over gains for workers, and certainly not in the first years following the broad opening up of China.

One might also think of compensating differentials: To take a job or stay in a job in a sector

or a firm where workers—due to offshoring—face the risk of being separated from their jobs or reallocated to less attractive job positions, the firm may have to offer workers a compensating differential. We consider this reasoning amounting essentially to a type of rent sharing: The management team at the firm still needs stable onshore labor, and workers use their bargaining power when they see profitability at the firm increases.

What we track in our estimates are changes to the level of firm fixed effects on firm average wages during a period. We do not track the composition of the level of worker-firm time-varying fixed effects. Thus, we stick to the concept of rent sharing when talking about estimated changes to worker-firm fixed effects. Note that the conclusions one draws form the two channels are diametrically opposite. The skill composition channel suggests what kind of jobs Danish firms offshore to China. This channel thus underlines an imminent concern for policy makers – how to compensate the workforce separated from their jobs as a result of offshoring. The rent sharing effect however underlines that there are positive sides to offshoring because it increases profitability of the firm and the firm shares part of the profits with its workers, thus contributing to improved welfare.

3. Data

Our main data source for this paper is the very rich, Danish, annual, matched, worker-firm panel from Statistics Denmark. The data currently spans from 1996-2008 and includes data from three linked databases, FIDA (1996-2008), IDA (1980-2008), and firm level External Trade Statistics (1990-2008). For our baseline results we use data on manufacturing firms only spanning from 1999-2005. All data are restricted and provided by Statistics Denmark.

FIDA is the Firm Integrated Database for Labor Market Research. It contains the (almost) full population of firms registered in Denmark. It provides accurate firm level data, including general, external accounting statistics, number of employees, and a record of individuals employed in the firms. Via a person key, FIDA can be linked to the Integrated Database for Labor Market Research (IDA), containing extensive information on socio-economic characteristics of the population of Danish residents. IDA variables include among others hourly wage, status on connection to labor market, age, sex, education, experience, tenure, and occupation. Education can broadly be classified in three categories: high skilled, requiring tertiary education; medium skilled, requiring vocational education defined as consumption of secondary education; and low skilled, defined as persons with short cycle education (typically 1-2 years) or high school education.

Via a firm key, we also link the worker-firm panel to firm level External Trade Statistics (1990-2008). This adds country-product level bilateral external trade data to our dataset.[10] Each trade flow contains information on the value of trade in DKK (f.o.b prices for exports and c.i.f prices for imports), the weight, and the volume. This dataset allows us to investigate the effect of a change in the incentive to offshore on firm level average wage.

Our main results are based on core manufacturing firms (NACE 15-36).[11] We consider firms with 10 or more employees. We also carry out robustness checks where we use our entire sample of firms. Our measure of offshoring is a broad one that includes firms' imports of both intermediate and consumption goods. For example a positive productivity or cost shock in China might affect offshoring decision of Danish firms, hence their imports and wages. In line with our theoretical motivation, firms that are able to import consumption and intermediate goods are able to expand their available potential technologies with associated increase in profitability that get translated into higher firm level average wage through rent sharing. Imports by manufacturing firms will also affect the kind of tasks (low skill and high skill) performed in the domestic firm and thus affect firm level skill composition. In our empirical analysis, imports as a share of sales proxy for offshoring at the firm level, and we proxy offshoring firms as those sourcing from abroad. Skill composition and rent sharing measures are constructed from the data using a worker level wage regression equation and explained in detail in the estimation strategy section. Table 1 provides comparison of firm level characteristics for the year 2005. Consistent with firm level findings in other countries, Danish firms that offshore are bigger in terms of employment and sales; have higher skill ratio (in terms of educated and non-educated workers), profits per employee and hourly wage, both on average and for each type of employee. For example offshoring firms have on average 85% higher employment and 36% higher sales than non-offshoring firms.[12] This result holds for other years in the sample as well. However, these results do not provide a causal mechanism from offshoring to higher wages, which we discuss in the following section.

4. Estimation

We are interested in assessing how a change in the incentive to offshore affects firm level average wage through the skill composition effect and the rent sharing effect. In the first step we show

[10] Product classification is the European Combined Nomenclature (CN), 8-digits. We use at the maximum 6-digit level which is consistent with HS-6 classification.

[11] Manufacturing firms best suit the underlying theoretical motivation and has often been used in empirical papers in the offshoring literature.

[12] The column to the far right of Table 1 presents results from simple mean difference regressions in Table 1 (i.e. statistical differences between means for offhoring firms and means for non-offshoring firms).

how firm level average wage can be split into a rent sharing component and a skill component. Our estimation strategy of decomposing firm level average wage essentially relies on the FKV technique. In the second step we relate the change in average wage and the two components arising from an exogenous shock in the incentive to offshore to China. We begin by discussing our second step: the identification strategy. Then we move on to our estimation method.

4.1. Identification Strategy. In this section we argue why we choose 2002-2005 as our shock period for our difference-in-differences estimations. 1999-2001 will act as our pre-shock period. In the following discussion we thus refer to the years 1999, 2001, 2002, and 2005 as they mark the beginning and the end of the two periods considered. We base our segregation of firms into control and treatment groups based on the firms' status in the first year of the two periods considered (i.e. 1999 or 2002).

To test how a change in offshoring opportunity affects firm level average wage through composition and rent sharing effects, we use events in China as exogenous shocks in the incentive to offshore to China. The events represent business condition, cost and productivity shocks in China and are likely to affect many local decisions of Danish firms. Our analysis does not compare the clean case of increasing wage differentials between firms offshoring and firms not offshoring. Instead, the estimations are carried out as increasing wage differentials between firms taking advantage of a new favorable offshoring destination and firms that do not.

China joined the WTO in December 2001, which was a very important event for the Chinese economy. An export boom occurred in China soon after China joined the WTO,[13] driven by the different policies undertaken by the Chinese government. These two events mark China's coming to the forefront as an important member in the global economy. China's accession to the WTO implied comprehensive liberalization, some of which would come into effect immediately whereas others were to be phased in over a period of typically less than three years. Some of the key components of China's accession to the WTO involved:

1. Gradual tariff reduction of agricultural and non-agricultural commodities. However the scope of tariff reduction was not massive, only 40% of about 10,000 products at HS8 level were eligible for tariff reductions over a period of five years with tariffs for the majority of the products being reduced by 2005.

[13] See Figure 1.

2. Services commitments involving substantial market opening of a broad range of service sectors, including banking, insurance, telecommunications, and professional services.

3. Phasing out of NTM such as licenses, quota, tendering state trading, export subsidy and removal of all WTO inconsistent non-tariff measures (NTMs) by 2005 as well as elimination of China's trade related investment measures (TRIMS).

4. Allowing all firms (whether domestic or foreign) the right to directly import from and export within three years from accession—also providing the right to engage in distribution of all products in China within three years of accession (except certain extended restrictions on chemical fertilizers, crude oil, and refined petroleum).

5. The provisions of systemic reforms involved broad reforms in the areas of transparency, notice and comment, uniform application of laws, and judicial review to help address barriers to foreign companies doing business in China.

6. China agreed to elimination of state-trading import monopolies for agricultural and industrial products and to the requirement that state-owned enterprises must make purchases and sales based solely on commercial considerations.

Accession to the WTO signaled credibility to the world that China was open for more foreign investment and trade. Given the enormous changes that were to take place to facilitate both foreign investment in China and imports from China to the rest of the world, China's accession to the WTO appears to be a shock of considerable magnitude to the incentive to offshore to China since it created a more conducive trading and business environment. This is the direct impact of China's joining the WTO on the offshoring incentive of Danish firms.

The WTO membership for China helped in spearheading further economic reforms, opened up the Chinese market for more international trade and higher levels of foreign investment, and opened up the world economy for Chinese exports. This, along with the various structural changes and liberalization policies adopted by the Chinese government around that time, led to a surge in China's exports soon after it joined WTO. Figure 1 shows that the surge in exports from China to the rest of the world was largest in 2003 and 2004. China's emergence as a major exporter has an indirect impact on firms' incentive to offshore from China from a third party competition angle. If a firm does not source inputs from China, but its rival firms (either in the same or a different country) do and reduce their costs and price, then the firm has to follow suit

or risk losing market share. Thus, as the rest of the world begins sourcing cheap inputs from China, we should expect firms in Denmark to behave similarly. One observation of interest is that though China joined the WTO in December 2001, we see exports increased the most from China to the rest of the world in 2003 and 2004. Two explanations are, first, that China had a transition phase to complete the liberalization, so the initial changes were not large enough to drive a large increase in exports immediately. Second, a small recession in the world economy in the post 9/11 crisis dampened the export growth from China in 2002. What is important in our context is that both these shocks, possibly related, and global in nature, are exogenous to a small open economy like Denmark and would not be affected by local firm behavior but would influence them.

From Figure 2 and Figure 3 we see that Danish firms, both manufacturing and non-manufacturing, reacted strongly to these episodes in China. Figure 2 shows the growth charts of Danish manufacturing imports from top non-EU15 partners and Eastern Europe. Imports from China (CN) by Danish manufacturing firms take off in 2003 while this is not true from Eastern European countries. These import responses are consistent with the surge in Chinese world exports.

Figure 3 shows the number of firms (manufacturing and non-manufacturing) importing from China as share of total firms, from 1999 to 2005. This pattern also holds for the number of firms importing from China, for example in 2002 both the total number of firms and manufacturing firms sourcing from China increased sharply, by 37% and 30%, respectively, by far the biggest increase during 1999-2005. From 2001 to 2005 the number of firms importing from China increased over two times from about 3000 to 7000, the corresponding numbers for manufacturing shows an increase by two times approximately from a little less than 500 firms in 2001 to about a 1000 in 2005 (tables not provided) . The above discussion indicates that Danish firms, both manufacturing and non-manufacturing, did respond to the shock of China's emergence as an emerging leading exporter following its accession to the WTO.

Because the number of firms sourcing from China has increased dramatically over a few years, we want to know about the nature of the firms that were sourcing from China before we see a surge in share of imports from China in 2003. We divide firms into the following four types: i) firms offshoring to China both in 2002 and 1999, ii) firms offshoring to China in 2002 but not in 1999, iii) firms offshoring to China in 1999 but not in 2002, and iv) firms offshoring to low middle-income countries but not China in 2002 and 1999 and non-offshoring firms, for the year 2002. In Table 2, a comparison of firm characteristics based on the types listed above, show

that the firms who were sourcing from China in 2002 but not in 1999 (new offshoring firms) are relatively smaller in terms of sales and employment compared to firms who were sourcing from China in both 1999 and 2002 (existing offshoring firms), as well as firms who were offshoring to China only in 1999 but not in 2002 (former offshoring firms). The omitted group consists of firms offshoring to low middle-income countries but not China and non offshoring firms in 2002 and 1999.

In Table 3a and Table 3b we present the growth rates (annualized) of imports in Danish manufacturing in 1999-2001 and 2002-2005, respectively. From these tables we see that the annualized growth rate in overall imports was lower in the 2002-2005 period than in the 1999-2001 period, when considering imports pooled across countries and also when we separate imports by high and low/middle income countries, except for China. The growth rate of imports from China was higher in 2002-2005 compared to 1999-2001. Moreover, the growth rate of total imports from China was 13 times the growth rate of overall imports in 2002-2005. The 1999-2001 annualized growth rate of overall imports from China was only about twice the growth rate of total imports. These tables also show the growing importance of Chinese imports in Danish manufacturing in 2002-2005 compared to 1999-2001. We also decompose the aggregate growth rate in each column into contributions from consumption goods and intermediate goods based on the BACI classification of HS6 products into stages of production . When comparing growth rates for consumption goods and intermediate goods for China with those of all countries (second column versus third), we again see that the growth rates of each type of good imported from China compared to other sources was higher in the 2002-2005 period, and of the total import growth rate 61-75 percent came from rising intermediate imports, the rest from consumption goods.

Unlike other papers in this literature, we do not restrict offshoring to be only intermediate goods imports for manufacturing firms; consumption goods imports are also considered as offshoring in this paper. In Table 4 and Table 5 we list consumption and intermediate commodities, respectively, based on the value imported in 2005 and 2001. Table 4a and Table 5a list top 20 commodities (based on their value of imports in 2005 in DKK) that are classified as consumption goods and intermediate goods respectively. For example Table 4a shows that boys jackets and trousers (HS6 products 620333 and 620343) are among the top products directly imported by Danish manufacturing firms from China in 2005. We consider this as offshoring: if the firms are making the garment designs in Denmark and producing the garments in China

and importing them back to Denmark, where they are labeled and packed then it constitutes as offshoring in our context because fragmentation of the production process occurs. Relocating production to China implies lower production costs, and that is likely to induce skill composition and rent sharing effects. Moreover many of the food products that are listed as consumption goods could very well be intermediate inputs in food manufacturing firms. Thus the fact that surge in imports from China to some extent is driven by consumption goods works well for the offshoring framework we have in mind. Table 6a indicates that most of the increase in Chinese imports was at the intensive margin; intensive margin being defined as commodities imported from China in 2002 as well as 1999 at the HS6 product category level.

Finally, Table 6b provides the decomposition by two broad firm categories those importing from China in 2002 and those not importing from China in 2002 but importing from China sometime between 2003 and 2005. We see that the former category contributes more towards the total change in imports from China between 2002-2005 period, mostly through the intensive margin; for the latter group, the entire change is by definition at the extensive margin.

4.2. Firm Level Average Wage Decomposition. We use the basic statistical framework of AKM for decomposing information on individual workers' wage into individual heterogeneity and firm heterogeneity. The linear worker-firm regression model of AKM with time-varying firm effect is

$$w_{it} = \alpha_i + x_{it}\beta + \psi_{j(i,t)} + \varepsilon_{it} \tag{2}$$

where i, j, and t are individuals, firms and time respectively. w_{it} is log wage; α_i is the time-invariant individual fixed effect. x_{it} is a vector of observable time-varying individual characteristics. So these components comprise the skill effect on individual wages. $\psi_{j(i,t)}$ is the time-varying firm effect. The function $j(i,t)$ indicates the firm in which worker i is employed in period t. We allow the firm effect $\psi_{j(i,t)}$ to vary over time to take into account changes in firms wage policies in response to trade shocks. ε_{it} is the residual, with the identifying assumption that $E[\varepsilon_{it}|i,t,x] = 0$ and is orthogonal to all other effects in the model.

Following FKV, we now decompose the firm average wage into an average rent sharing component and an average skill component. The way we do is by subtracting from the variables their mean across individuals at each point in time. Note from equation 2 that

$$\alpha_i = w_{it} - x_{it}\beta - \psi_{j(i,t)} - \varepsilon_{it}$$

Recalling that $E(\varepsilon_{it}) = 0$, we then define the mean deviation of α_i at time t as

$$\tilde{\alpha}_i \equiv \alpha_i - \bar{\alpha}_i = \alpha_i - E(w_{it} - x_{it}\beta - \psi_{j(i,t)}) - \varepsilon_{it}$$

The sample analogue of the expression above uses the estimated parameters $\hat{\alpha}_i$, $\hat{\beta}$, and $\hat{\psi}_{j(i,t)}$ of equation 2:

$$\widehat{\tilde{\alpha}}_i \equiv w_{it} - x_{it}\hat{\beta} - \hat{\psi}_{j(i,t)} - \bar{w}_{it} - \overline{(x_{it}\hat{\beta})} - \overline{\hat{\psi}}_{j(i,t)}$$

Define $\tilde{s}_{it} \equiv s_{it} - \bar{s}_t = \tilde{\alpha}_i + x_{it}\beta - \overline{x_{it}\beta}$ as the mean deviated value of s_{it} and introduce, as above, the sample analogue:

$$\hat{\tilde{s}}_{it} \equiv \hat{s}_{it} - \bar{\hat{s}}_t = \widehat{\tilde{\alpha}}_i + x_{it}\hat{\beta} - \overline{x_{it}\hat{\beta}}$$

Insert the expression for $\widehat{\tilde{\alpha}}_i$, reduce, and rearrange. We get the individual mean deviated wage as:

$$w_{it} - \bar{w}_t = \hat{\tilde{s}}_{it} + \left(\hat{\psi}_{j(i,t)} - \overline{\hat{\psi}}_t\right) \tag{3}$$

Taking the average across individuals within each firm j, we arrive at the split of firm average wage into an average skill component and a rent sharing component, expressed in values as mean deviated by individual means at time

$$\underbrace{\left(\frac{1}{N_{jt}}\sum_{i=1}^{N_{jt}} w_{it}\right) - \bar{w}_t}_{\text{firm avg. wage (deviated)}} = \underbrace{\left(\frac{1}{N_{jt}}\sum_{i=1}^{N_{jt}} \hat{\tilde{s}}_{it}\right)}_{\text{avg. skill comp. (deviated)}} + \underbrace{\left(\hat{\psi}_{j(t)} - \overline{\hat{\psi}}_t\right)}_{\text{rent sharing (devaited)}} \tag{4}$$

Denoting the mean deviated variables at the firm level in equation 4 as $\breve{y}_{jt} = y_{jt} - \bar{y}_t$, we now have the variables $\breve{w}_{jt}$, $\breve{s}_{jt}$, and $\breve{\psi}_{jt}$. Analogous to equation 2, we can write

$$\Delta\breve{w}_{jt} = \Delta\breve{s}_{jt} + \Delta\breve{\psi}_{jt}$$

where Δ indicates the time difference of the variables $\breve{w}_{jt}$, $\breve{s}_{jt}$, and $\breve{\psi}_{jt}$ from year $t-1$ to year t (i.e. our difference-in-differences observations of dependent variables in our analysis).

Using these three variables as our dependent variables in difference-in-differences estimations allows us to break down the coefficient on the treatment dummy in the $\Delta\breve{w}_{jt}$-regressions into

the coefficients of the treatment dummies in the $\Delta\check{s}_{jt}$- and $\Delta\check{\psi}_{jt}$-regressions, respectively. Thus, we track changes in firm average wages and contribute the reason to either skill-compositional changes, rent-sharing effects from increased profitability, or both. Once again we underline that results from this split leads to completely different policy conclusions: Skill compositional changes underline that Danish firms do offshore low-skill jobs, but rent sharing effects increase wage for workers at the Danish firms which adds a positive welfare story to offshoring that has direct positive impact on workers at the firm.

4.3. Estimation Equations:. We test our theoretical motivation that we have boiled down to equation (1) in section 2, using two types of difference-in-differences (DiD) estimations and a set of outcome variables. Based on the identification discussion earlier we define our *shock period* to be 2002-2005 and a *pre-shock period*[14] to be 1999-2001. Our DiD equations are:

$$\Delta y_{kj} = \alpha + \beta + d\_2002 + D_j + \varepsilon_{kj} \tag{5}$$

$$\Delta y_{kj} = \alpha + \beta_1 d\_1999\_2002 + \beta_2 d\_0\_2002 + \beta_3 d\_1999\_0 + D_j + \varepsilon_{kj} \tag{6}$$

Δy_{kj} is the change in an outcome variable of interest for firm k in industry j (D_j captures industry fixed effects). We consider the difference over 2002-2005. In equation 5 d_2002 is a dummy variable for firms offshoring to China in 2002. Thus d_2002 is our treatment firms; control firms (omitted group) are firms who offshore to other low-middle income countries but not China as well as firms that do not source inputs from abroad in 2002.[15][16]

Equation 6 carries out difference-in-differences estimates by firm types, depending on when they were offshoring to China prior to 2003. As mentioned in the data section, the types that we consider are: d_1999_2002, firms sourcing from China in both 1999 and 2002; d_0_2002, firms offshoring to China in 2002 but not in 1999; d_1999_0, firms offshoring to China in 1999 but not in 2002. The omitted group is non-offshoring firms and firms not offshoring to China but other low middle income countries. The main outcome variables of interest are 1) firm level average wage, 2) skill composition, and 3) rent sharing. All results in the next section use Danish manufacturing firms only (NACE 15-36).

[14] *To test for trend differences in a DiDiD.*

[15] Results are similar using other treatment and control group. See Section 6 on robustness.

[16] We do not include firms importing from high income countries in our control group because the products they import might not be comparable to those obtained from low/middle income countries in terms of price and quality.

We carry out all estimations following two parallel tracks: One track utilizing only typical firm level information, and a second track making full use of the worker-firm matched data. Comparing these two approaches demonstrates the fruitfulness of having worker-firm matched data even though the scope is firm level analyses.

5. Results

5.1. Estimating Results from Firm Level Data. We begin by looking at firm level variables before decomposing firm level average wages into skill composition and rent sharing components from worker level regression. Typically, firm level datasets give skill ratio (skilled vs. unskilled), sales per employee (rent sharing). Apart from gauging the impact of the shock on various firm level outcomes, this exercise allows us to compare our results obtained from using more nuanced measures of skill composition and rent sharing effects by taking full advantage of linked worker-firm information with those that are commonly used in the literature and readily available in typical firm level datasets. The skill ratio that we use in this section is the traditional measure based on education of the employee; skilled labor being those having more than high school education and unskilled are those with high school or less than high school level of education.

Table 7 shows the estimation of equation 5. From columns 1 and 3 we see that average wage and skill ratio differentials changes are 1.5% and 3.6%, respectively, higher for firms offshoring to China in 2002 compared to the control group. Columns 2 and 5 indicate that employment and sales differentials are 6.2% and 5.1%, respectively, less for firms offshoring to China in 2002 compared to those who were not. The sales figure that we have represents export and domestic sales of the firm from Denmark, so one possible reason for negative differential increase in the value of sales[17] could be due to reduction of prices of commodities through reducing cost by offshoring to China.[18] Interestingly, there is no statistically significant change in sales per employee. If sales per employee is taken as a proxy for revenue based rent sharing then this result indicates that skill composition is the only channel through which wages are affected, due to offshoring, between treatment and control firms in this period. Column 6 indicates that imports as share of sales (offshoring) are 1% higher for treatment firms than for control firms during the 2002-2005 time period, showing that Danish firms offshoring to China in 2002 are

[17] I.e. treatment firm sales increase less from 2002 to 2005 than control firm sales do. Recall these are difference in differences in sales.

[18] It can also be offshore exports to third-party country.

better able to take advantage of the liberalized business environment change in China and hence fall in cost of offshoring to China.[19]Moreover, though Chinese trade has become important for Denmark over the years, it constitutes about 5% of manufacturing imports.

Since the number of firms importing from China has increased over the years we carry out the difference-in-differences estimation over 2002-2005 by breaking down types of firms depending on when they were offshoring to China and see if any differential results emerge among the types of firms. Table 8 shows our findings; the types we are interested here are firms offshoring to China both in 2002 and 1999; firms offshoring to China in 2002 but not in 1999; firms offshoring to China in 1999 but not in 2002; firms offshoring to low middle-income countries but not China and non-importing firms (the omitted group).

Results in Table 8 show that firms offshoring to China in 2002 but not in 1999 experience the highest differential wage increases. Firms present in China in both 1999 and 2002 also show increase in average domestic wages in this period but less than firms new to sourcing inputs from China. Similarly, the change in employment is stronger for the firms newly offshoring to China. Just as in Table 7, column 4 in Table 8 indicates no differential labor productivity (sales-per-employee) changes between the different types of firms in the 2002-2005 period.

Because China's joining the WTO was anticipated, we may worry that our treatment firms are responding to the shock by changing their technology before 2002 to take better advantage of cheaper Chinese resources. The findings in Table 8 alleviate that worry. Though the accession was anticipated, there was quite a lot of uncertainty in Denmark about the suitability of offshoring to China, apart from the various restrictions that were not to be dismantled till after China joined WTO. Likely, this uncertainty prevented firms from increasing the level of offshoring to China in anticipation of the future changes. Hence, although firms could foresee new offshoring opportunities due to long drawn WTO negotiations, it is unlikely that they could take advantage of it before the liberalizations came into effect. The results in column (6) provides support to this idea; since the change in offshoring was higher for the two types of firms importing from China in 2002,[20] compared to the omitted group, we can conclude that

[19]The control group includes non-offshoring firms, inflating the effect if they do not choose to offshore during the period. On the other hand, some of them could choose to offshore in 2003, 2004 or 2005, which could imply arbitrarily large jumps in import shares (from zero to something) compared to the treatment firms that mostly offshored to somewhere else than China at the beginning of 2002. Thus, presence of non-offshoring firms in the control group could also understate the effect. However, excluding these (few) non-importing manufacturers does not change results much. Thus, for consistency we decide to stick to the same sample as for the other estimations in Table 7.

[20]i.e. firms continuing offshoring from China, and firm new to offshoring from China.

both types of offshoring firms responded to the shocks by increasing the share of imports from China in the 2002-2005 period. The results in this table also indicate that the wage increases we witness in Table 7 are most pronounced for the firms that decide to offshore to China around 2002. This finding coupled with results in descriptive statistics in Table 2 lends support to the idea that China's accession to the WTO and the soon after surge in Chinese exports was more important for the relatively smaller and less productive firms who could not take advantage of Chinese imports prior to 2002 because of restrictive business environment in China; they began offshoring to China once China joined the WTO and also saw a surge in exports soon after.

To ensure that the results observed in Table 7 and Table 8 are indeed driven by the shock and not by differential trend between the more productive treatment firms compared to the less productive control firms, we need to check that the observed change in the outcome variable was greater during the period 2002-2005 than in other periods.

We consider the pre-shock period 1999-2001. We estimate an equation similar to equation 6, taking the difference in the change in the outcome variable of interest over 2002-2005 from 1999-2001 and regressing it on the three types of firm dummies. This essentially leads to a triple-differences strategy which purges any differential trend for the firms. Results in Table 9 indicate that the differential change in average wage is the largest for firms new to offshoring from China in 2002 (d_0_2002). Average wage changed 3.6% more for these firms in the 2002-2005 period than in the 1999-2001 period compared to control firms. Skill ratio changes—though positive—are not significant. Differential change in sales per employee (column 4) between the two periods is not significant either for the new offshoring firms (d_0_2002) compared to the omitted group. To sum up, though we find that events in China caused differential outcomes in 2002-2005 between treatment and control firms over and above their basic underlying trend differences, using crude proxies for skill composition and rent sharing cannot explain what is driving the observed differential wage increase. Since skill includes much more than education and rent sharing might not just mean sharing revenue, we now use information on workers' wage histories in our worker-firm data to construct more rigorous measures of skill composition and rent sharing effects.

5.2. Estimating the Effects from a Worker-Firm Regression. We first estimate a standard AKM-type model (equation 2) with time-varying firm effects. The inclusion of time varying firm effects allows us to address changes in firm wage policies following trade shocks. As time varying returns to individuals we include linear and quadratic terms for experience and

age, and education (high skill: tertiary education; medium skill: vocational education; omitted group: high school or less). Table 10 shows the estimates from our worker-firm regression. As expected, more years of experience are associated with higher wages and there are diminishing returns to experience. Similar results are also true for age. Unsurprisingly, high skilled workers and medium skilled workers earn more than low—or unskilled—workers.

We then estimate the effect of the shock on firm level average wage through the two effects constructed from the worker-firm regression using estimation equations 5 and 6. Table 11 presents results for difference-in-differences estimates for equation 5 over the 2002-2005 period. In this section we now find that average wages (deviated from annual mean) increased 1.2% more for firms offshoring to China in 2002 than control firms and both skill composition and rent sharing are responsible for this increase—both significant at the 10% level. Skill composition increased 0.3% more for firms offshoring to China in 2002 and explains about 25% of the wage increase. Rent sharing increased 0.9% more for firms offshoring to China in 2002 and accounts for as much as 75% of the wage increase.

To ensure that the difference we observe is driven by the shock, we carry out a triple differences estimation similar to Table 9, by regressing the changes in our outcome variables of interest (firm level average wage, skill composition and rent sharing deviated from their respective annual means) between 2002-2005 and 1999-2001 periods, on the different firm dummies. The results for wages corroborate what we found earlier. Table 12 shows significant (at 10%-level) differential wage gains for firms new to offshoring from China (d_0_2002). Now we can say what is driving that wage differential: rent sharing only. Interestingly, for firms offshoring to China in both 1999 and 2002, the differential gain in wages between the two periods is explained more by skill composition effect—rent sharing though positive is insignificant. For firms offshoring to China only before 2002, all the outcome variables have negative sign, though none are significant. The fact that wages increased differentially for the firms offshoring to China in 2002 is in line with the underlying theory. Moreover, we arrive at the apparent puzzle: the mechanisms behind the differential wage increase between the two periods (2002-2005 and 1999-2001) is different for relatively the smaller firms offshoring to China in 2002 but not in 1999 and relatively larger firms offshoring to China in both 2002 and 1999. A glance at our data in Table 2 shows that the firms offshoring to China in 2002 and not in 1999 (d_0_2002) are smaller than firms offshoring to China in both 1999 and 2002 (d_1999_2002). Thus, the former firms are likely to have more homogeneous workers in terms of skill over the years and that could explain

why their differential change in skill composition between the two periods is small. Bigger firms continuing to offshore to China are likely to have more diverse workforce hence their wage increase is accounted for by both mechanisms. Again, comparing results in Table 9 and Table 12 suggest that using measures of skill composition and rent sharing using worker-firm matched data allows us to take into account aspects of average wage determination that is not captured by traditional measures of skill based on education and rent sharing based on revenue sharing.

5.3. Robustness Check. In this section we carry out different robustness tests to strengthen our main results.

As a first check we re-estimate our main equation using alternate firm dummies, to see whether there was any differential wage effect for firms who began offshoring from China between 2003-2005, though their decision to do so was possibly endogenous. The firm types that we consider are d_2002: firms offshoring to China in 2002; d_2003_2005: firms offshoring to China after 2002, i.e. sometime in 2003-2005 period but not doing so in 2002; the omitted group are firms not offshoring to China between 2002-2005 but offshoring to other low-middle income countries and non-offshoring firms. Table 13 provides qualitatively similar results for the firms offshoring to China in 2002 ($d\_2002firms$) as found in Table 11. Both skill composition and rent sharing effects explain the higher change in wages and the latter channel explains more of the increase for these firms. We also see that there are wage gains for firms offshoring to China after 2002 (d_2003_2005 firms), mostly via the skill composition effect, so firms that began offshoring to China later have also gained. Table 14 presents a triple differences estimate by comparing the differential change in the change in our outcome variables of interest over 1999-2001 period and 2002-2005 period. The results indicate that there are differential gains in wages between the two periods for both types of firms, and both channels matter.

We carry out our main estimation using manufacturing firms only. We re-run the main estimations with all firms: manufacturing, services and retail/wholesale firms. The reason is twofold. First, our data reveals that firms switch status over the years; so a manufacturing firm might become a service or retail firm by offshoring its manufacturing operations. These firms would drop from our manufacturing sample and thus might lead to under-estimation of the effects of offshoring on our variables of interest. Second, the impact of the shock was also very pronounced for non-manufacturing firms as discussed in section 4.1. The results, displayed in Table 15, are consistent with our main results presented in Table 10, though coefficient estimates are now larger. We see there was wage gain for firms offshoring to China in 2002, and relatively

more of that increase is explained through rent sharing. Triple differences estimation results in Table 16 again show that most of the differential increase is for the firms importing from China in 2002 but not 1999, but now only skill composition effects significantly explain that increase, and just roughly half of the differential gain. The other half cannot significantly be attributed rent sharing. There is also differential increase in wages observed for the firms importing from China in 2002 and in 1999, and that increase is still explained only through the skill composition effect and completely dominate the total effect on average wages.

What if the effects we see are not from the firms' new activities in China but instead from offshoring to other, similar countries? That is a very relevant concern. We have run our procedures on other similar countries and former Eastern European countries among which many are now part of the EU and not low-income countries anymore. We find no results. Recall that we have a well-sustained argument for an unanticipated shock for Danish firms, particularly for small firms—even though China's accession was anticipated. In fact, running our regressions on a subsample of small firms—10-50 employees—show even stronger average effects. We see no other shocks of arguably same scale. The case of the Czech Republic demonstrates nicely why effects must come from China's accession to the WTO acting as an unanticipated shock: very few of the treatment firms also offshore to the Czech Republic. The reason is that many of the firms are relatively new to offshoring and have few common source countries apart from China (see Table 18).

In 2005, growth in imports from Eastern European countries starts to pick up lowering the ratio of China imports relative to Eastern Europe import to 1.7.[21] To exclude this possible source of gains from offshoring to countries other than China from our results on the treated groups we run the estimations with the shock period defined as 2002 to 2004 instead of 2002 to 2005. Our qualitative results hold and estimates are—perhaps contrary to one's a priori beliefs—generally higher (see Table 19). Combined with the robustness check from other countries just discussed above in this section, we are confident that our results stem from the opening up of China as a sourcing destination and the dominating shock for our treatment groups. We do still refer to the results based on 2002-2005 as our main results because growth in imports from China still dominates any other sourcing destination in 2005 and thus define by when imports from China in an absolute amount truly takes off.

[21] The ratio ranges between 1.7 and 10 during the period 2002 to 2005, cf. Figure 2

6. Conclusion

This paper uses rich linked worker-firm data from Denmark to address how offshoring affects firm level average wage. We use China's accession to the WTO in December 2001 and the boom in Chinese exports soon after, as an exogenous shock to the incentive to offshore to China by Danish firms. This shock allows us to identify the causal effect of offshoring on wages.

Unlike other papers in this literature, we consider different possible channels– namely skill composition and rent sharing effects– to explain offshoring induced gains in firm average wages. A skill composition effect increases average wage if firms send low-skilled jobs abroad retaining high skilled workers at home who require higher pay. A rent sharing effect increases average wage if firms share offshoring induced increase in profits with all existing worker. Our findings show that firms sourcing from China in 2002 had higher increase in average wages between 2002 and 2005 compared to the control group.[22] We find that both skill composition and rent sharing effects significantly matter in explaining the wage gain. Moreover, it is important to separate out the effects of the two channels since they have different policy implications. While the presence of the skill composition effects does underline that Danish firms offshore certain jobs, the presence of the rent sharing effect highlights that firms offshoring to China also enjoy increased profitability and share that with employees. The important result to highlight here is that the timing of when a firm is exposed to a shock to the incentive to offshore matters. In our case: Firms present in China before China's accession to the WTO in December 2001 offshored jobs using relatively unskilled labor. Whereas, firms not present in China before the time of accession increased profitability and shared these increases with their employees, thus pointing to increased welfare. These firms however did not offshore relatively more any particular skill type of job. One possible explanation for this could be the size difference of the two types of firms and hence their workforce composition. Smaller manufacturing firms (less than thirty employees) are likely to have more homogeneous workforce and for them the average skill level of the workers might not change much over the years. Bigger firms already offshoring to China are likely to have more diverse workforce and hence for them both composition and rent sharing matter for the wage increase. However, the skill composition effect significantly explains about half that gain while the other half explained by the rent sharing effect is not statistically significant.

Though we carry out estimations at the firm level, we fully utilize the worker-firm match data. Following Frias, Kaplan & Verhoogen (2012) we decompose the effects on average wages

[22] Firms offshoring to low middle income countries but not China and non-offshoring firms.

into estimated effects due to skill composition changes and changes due to rent sharing. We compare these results with results obtained using measures of skill composition and rent sharing available from typical firm level data. We show that using linked worker-firm data allows us added insight behind the wage increase mechanism because, in our case, the two sets of results do not conform; ratio of educated to uneducated workers as a traditional measure for skill composition and sales per employee as a measure of rent sharing cannot explain the average wage increase. Our measure of composition and rent sharing constructed from the worker level wage regression of the AKM type do.

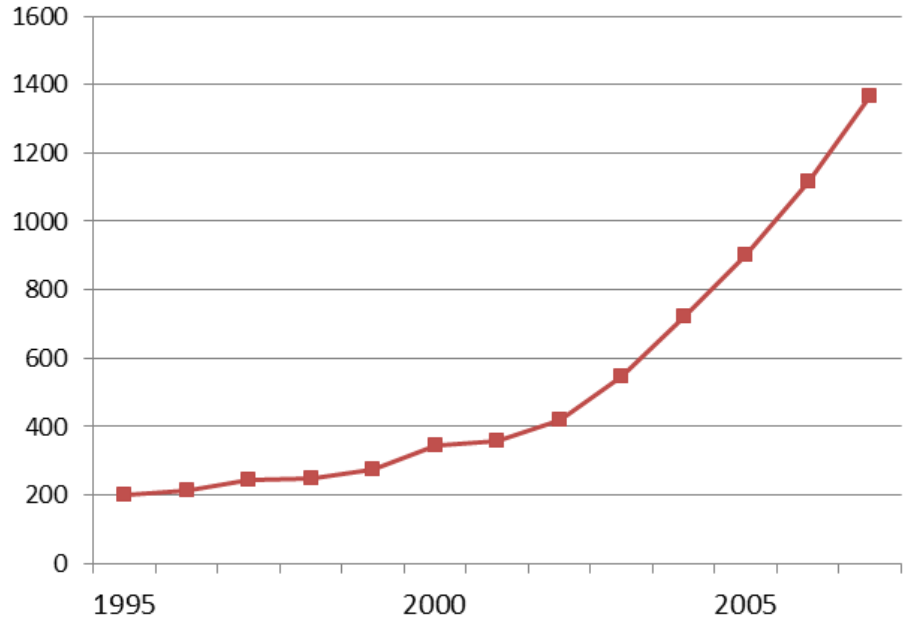
Appendix

Table 1: Comparison of manufacturing firm characteristics between offshoring and non-offshoring firms in 2005

	All firms	**Offshoring firms**	**Non-offshoring firms**	**Regr. Mean difference**
No. of firms	5281	3007	2274	
Means				
Log (employees)	3,41 (1)	3,78 (1,09)	2,93 (0,56)	0.85*** (0,02)
Log (sales)	17,05 (1,36)	17,70 (1,31)	16,19 (0,87)	1.20*** (0,03)
Skill ratio, edu/non-edu	3,65 (3,88)	3,76 (4,15)	3,50 (3,47)	0.26** (0,11)
Log (EBIT per worker)	10,83 (1,1)	11,08 (1,12)	10,51 (0,99)	0.36*** (0,04)
Log (hourly wage)	5,20 (0,19)	5,25 (0,17)	5,14 (0,21)	0.06*** (0,01)

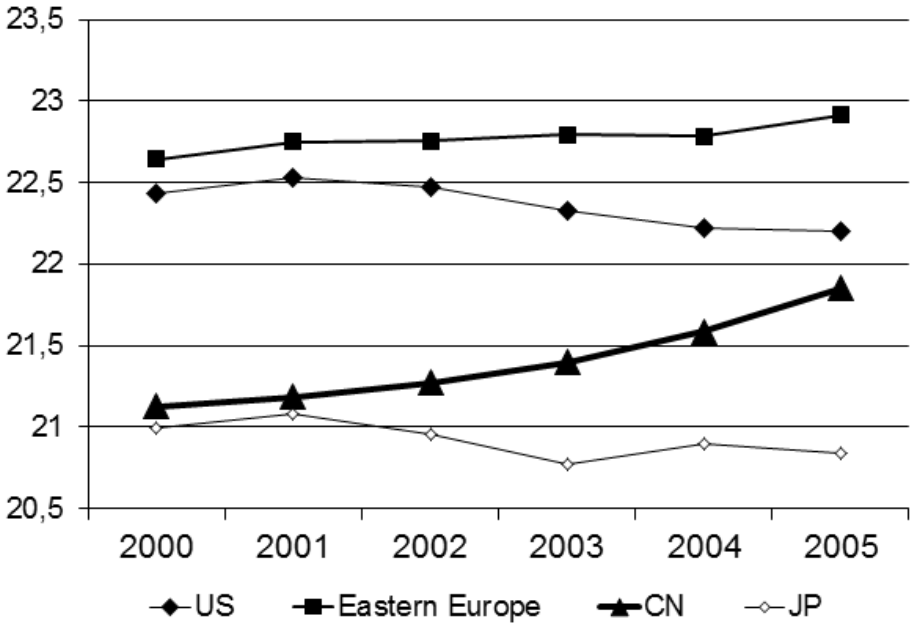
Note: Educated (edu.) means have more than high school education and non-educated (no edu.) refers to less than or equal to twelve years of education. The last column gives difference in the means between offshoring and non-offshoring firms; all regressions include industry fixed effect and employment is included as additional control in all regressions except log(employees).

Figure 1: Chinese Exports in Billions of US Dollars



Source:

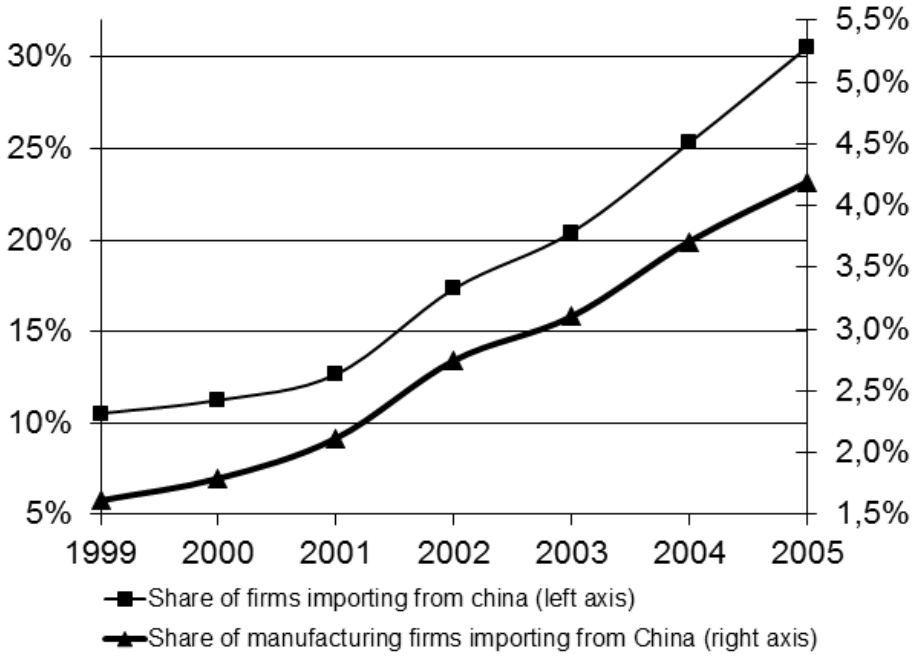
Figure 2: Danish manufacturing imports (in logs) from selected partners and groups of partners



Note: Growth rates of imports from China are between two and ten times the growth rates of imports from Eastern Europe between 2002 and 2005.

Source: External firm level trade statistics, Statistics Denmark, own calculations

Figure 3: Share of Danish Firms Sourcing from China



Source: External firm level trade statistics, Statistics Denmark, own calculations

Note: Values on left hand axis relate to share of all firms importing from China. Values related to share of manufacturing firms importing from China are on the right hand axis.

Table 2: Comparison of firm characteristic by type in 2002

	wage	sales/emp	sales	emp
Existing Offshoring	0.082***	0.621***	2.18***	1.56***
Firms	(0.012)	(0.041)	(0.112)	(0.096)
New Offshoring	0.049***	0.55***	1.88***	1.33***
Firms	(0.016)	(0.054)	(0.128)	(0.116)
Former Offshoring	0.084***	0.682***	2.12***	1.44***
Firms	(0.03)	(0.143)	(0.251)	(0.235)
N	3336	3337	3337	3337

Note: Robust standard error in the parenthesis. All regression includes industry fixed effects. The omitted group is firms not offshoring to China but offshoring to other low-middle income countries and non-offshoring firms in 1999/2002.

Table 3: Import growth contributions

Table3a: Import growth contributions (annualized) in per cent of base total (1999-2001)

	All	**China**	**Low/med income**	**High income**
Consumption	2.1	6.2	3.1	2.0
Intermediate	8.6	18.2	12.7	8.3
Total	10.7	24.4	15.8	10.3

Source: External firm level trade statistics, Statistics Denmark, own calculations
Notes: Classification of consumption goods and intermediate goods follow the BACI classification from CEPII. Low/med income group excludes China.

Table 3b: Import growth contributions (annualized) in per cent of base total (2002-2005)

	All	**China**	**Low/med income**	**High income**
Consumption	0.1	10.5	-1.7	0.1
Intermediate	2.0	17.0	12.1	1.1
Total	2.1	27.5	10.3	1.2

Source: External firm level trade statistics, Statistics Denmark, own calculations
Notes: Classification of consumption goods and intermediate goods follow the BACI classification from CEPII. Low/med income group excludes China.

Table 4: Ranking Imported Consumption Products

Table 4a: HS6 Manufacturing imported consumption goods		**2005**	**2002**	**Rank in 2002**
160540	Crustaceans nes, prepared or preserved	53340799	1311804	52
711719	Imitation jewellery nes of base metal including plate	43417328	9816229	6
940360	Furniture, wooden, nes	38544723	1117227	61
030420	Fish fillets, frozen	33941755	3303811	23
620333	Mens, boys jackets, blazers, synthetic fibre, not kni	33804627	179689	152
620343	Mens, boys trousers shorts, synthetic fibre, not knit	32858528	12386218	4
392690	Plastic articles nes	26146710	17187523	2
940179	Seats with metal frames, nes	24050163	908627	75
950390	Toys nes	23540912	5684666	15
940490	Articles of bedding nes	21799778	8238720	9
630790	Made up articles (textile) nes, textile dress pattern	21016679	8610865	8
490199	Printed reading books, except dictionaries etc	20984376	7848889	10
940140	Seats convertible into beds	20758743	10773086	5
902190	Orthopaedic appliances, nes	18376033	4452192	19
950330	Construction sets and constructional toys, nes	17444588	1008915	67
620332	Mens, boys jackets & blazers, of cotton, not knit	16619985	370365	122
940161	Seats with wooden frames, upholstered nes	16251353	600429	92
620462	Womens, girls trousers & shorts, of cotton, not knit	13046353	853358	77
851629	Electric space heating nes and soil heating apparatus	12438464		
611030	Pullovers, cardigans etc of manmade fibres, knit	10878943	1957272	37

Table 4b: HS6 Manufacturing imported consumption goods		**2001**	**1999**	**Rank in 1999**
850980	Domestic appliances, with electric motor, nes	25840768		
392690	Plastic articles nes	18687247	6150690	12
610711	Mens, boys underpants or briefs, of cotton, knit	16505069	18054200	3
030420	Fish fillets, frozen	14937704	136284	146
620343	Mens, boys trousers shorts, synthetic fibre, not knit	14733910	2602090	23
902190	Orthopaedic appliances, nes	12922589	6737316	9
950330	Construction sets and constructional toys, nes	11641092	3671195	19
040900	Honey, natural	9237678	4331478	18
030619	Crustaceans nes, frozen,	9110324	6118847	13
420231	Articles for pocket or handbag, leather outer surface	8706212	4630337	16
841840	Freezers of the upright type, < 900 litre capacity	8292136	1909480	33
940490	Articles of bedding nes	8131019	11693002	5
420292	Containers nes, outer surface plastic or textile	7603965	921955	51
950390	Toys nes	7148450	2346638	26
821599	Cutlery not in sets, not plated with precious metal	6836842	5752128	14
630790	Made up articles (textile) nes, textile dress pattern	6714122	21671684	2
640291	Boots, soles/uppers rubber or plastic, over ankle, ne	6486472		
611090	Pullovers, cardigans etc of material nes knit	6417276	611280	67
490199	Printed reading books, except dictionaries etc	5820386	6725830	10
660110	Garden and similar umbrellas	5793580	2503043	24

Source: External firm level trade statistics, Statistics Denmark, own calculations

Notes: Amounts are in DKK. . Classification of consumption goods and intermediate goods follow the BACI classification from CEPII. Rank gives the position of the commodity in DKK in the year 2002 and 1999.

Table 5: Ranking Imported Intermediate Products

Table 5a: HS6 Manufacturing imported intermediate goods		**2005**	**2002**	**Rank in 2002**
848180	Taps, cocks, valves and similar appliances, nes	126744085	31182357	9
870839	Brake system parts except linings for motor vehicles	107457536	34315	307
848190	Parts of taps, cocks, valves or similar appliances	99517689	71550756	2
853400	Electronic printed circuits	82899720	39798006	6
732510	Cast articles, of non-malleable cast iron nes	62931197	1049846	103
841391	Parts of pumps for liquids	49542779	44151963	5
730723	Pipe fittings, butt welding of stainless steel	47028226	10519817	23
350790	Enzymes nes, prepared enzymes nes, except rennet	45636175	20757774	15
940390	Furniture parts nes	40444629	5836004	32
852990	Parts for radio/tv transmit/receive equipment, nes	39835005	3784459	50
852190	Video record/reproduction apparatus not magnetic tape	36282907	2326	419
730890	Structures and parts of structures, iron or steel, ne	29505922	5427577	35
851890	Parts of non-recording electronic equipment	27387806	27234039	12
901920	Therapeutic respiration apparatus	27136114	3227836	54
848130	Valves, check	26261257	3844912	48
840999	Parts for diesel and semi-diesel engines	26028088	1760985	76
852090	Audio recording equipment without sound reproduction	25299813	4917146	39
850431	Transformers electric, power capacity < 1 KVA, nes	22112709	29551079	10
850440	Static converters, nes	20603780	54295373	4
853690	Electrical switch, protector, connecter for < 1kV nes	18316477	2005028	72

Table 5b: HS6 Manufacturing imported intermediate goods		**2001**	**1999**	**Rank in 1999**
851822	Multiple loudspeakers, mounted in single enclosure	114262840	32312257	6
760429	Bars, rods and other profiles, aluminium alloyed	67087534		
841391	Parts of pumps for liquids	56487117	29320032	7
853400	Electronic printed circuits	40652653	3689736	33
851890	Parts of non-recording electronic equipment	35982391	6541136	22
848180	Taps, cocks, valves and similar appliances, nes	34947270	150615	136
848190	Parts of taps, cocks, valves or similar appliances	33820169	5482547	23
851829	Loudspeakers, nes	28085847	343302	103
850431	Transformers electric, power capacity < 1 KVA, nes	27948139	586888	91
730729	Pipe fittings of stainless steel except butt welding	26270529	46720486	3
392340	Plastic spools, cops, bobbins and similar supports	26226470	32682536	5
293627	Vitamin C, derivatives, unmixed	23789420	21150890	8
121230	Apricot, peach and plum stones & kernels, human food	17860915	8777163	16
680100	Stone setts, curbstones, flagstones (except slate)	17197610	3743352	32
854441	Electric conductors, nes < 80 volts, with connectors	16348712	888264	74
902140	Hearing aids, except parts and accessories	16298009	33694520	4
871491	Bicycle frames and forks, and parts thereof	14209632	7315550	19
852290	Parts and accessories of recorders except cartridges	13885985		
900190	Prisms, mirrors and optical elements nes, unmounted	11352433	4741506	28
940520	Electric table, desk, bedside and floor lamps	10565394	566506	92

Source: External firm level trade statistics, Statistics Denmark, own calculations

Notes: Amounts are in DKK. . Classification of consumption goods and intermediate goods follow the BACI classification from CEPII. Rank gives the position of the commodity in DKK in the year 2002 and 1999.

Table 6: Decomposing imports

Table 6a: Decomposing imports from China (2002-2005)

	Change	**Margin shares of trade increase**	
	(M DKR)	Extensive	Intensive
Consumption	489	25%	75%
Intermediate	795	37%	63%
Total	1284	32%	68%

Source: External firm level trade statistics, Statistics Denmark, own calculations
Notes: Classification of consumption goods and intermediate goods follow the BACI classification from CEPII. Low/med income group excludes China.

Table 6b: Decomposing imports from China (2002-2005) by firm types

	Firms Offshoring to China in 2002			**Firms offshoring to China in 2003- 2005**		
	Change	**Margin shares of trade increase**		**Change (M**	**Margin shares of trade increase**	
	(M DKR)	**Extensive**	**Intensive**	**DKR)**	**Extensive**	**Intensive**
Consumption	350	30%	70%	139	100%	0
Intermediate	426	39%	61%	369	100%	0
Total	776	35%	65%	508	100%	0

Source: External firm level trade statistics, Statistics Denmark, own calculations
Notes: Classification of consumption goods and intermediate goods follow the BACI classification from CEPII. Last column contains firms offshoring to China in 2003-2005 period but not 2002.

Table 7: Difference-in-difference Estimate (2002-2005)

	1	2	3	4	5	6
	Δl(avgwage)	Δemp	Δsk_ratio	Δ(sales/emp)	Δsales	Δoffshore
Offshoring in 2002	0.015***	-0.062***	0.036***	0.011	-0.051**	0.010***
	(0.005)	(0.018)	(0.011)	(0.020)	(0.023)	(0.002)
N	2119	2119	2119	2119	2119	2119

Note: Robust standard error in the parenthesis. All regression includes industry fixed effects. ***,**,* indicate significance at 1,5,10 percent levels respectively. Dependent variable is differenced over 2002-2005 period.

Table 8: Difference-in-difference estimate by firm types (2002-2005)

	1	2	3	4	5	6
	Δ l(avgwage)	Δ emp	Δ sk_ratio	Δ sales/emp	Δ sales	Δoffshore
Existing Offshoring Firms	0.015**	-0.087***	0.048**	0.003	-0.084**	0.02***
	(0.006)	(0.027)	(0.020)	(0.028)	(0.036)	(0.005)
New Offshoring Firms	0.027***	-0.154***	0.041*	0.005	-0.148***	0.013***
	(0.009)	(0.038)	(0.022)	(0.040)	(0.050)	(0.004)
Former Offshoring Firms	0.003	-0.133	0.006	-0.061	-0.195***	0.004
	(0.016)	(0.092)	(0.033)	(0.106)	(0.067)	(0.002)
N	1915	1915	1761	1915	1915	1915

Note: Robust standard error in the parenthesis. All regressions include industry fixed effects. ***,**,* indicate significance at 1,5,10 percent levels respectively.

Table 9: Triple Difference Estimate by Firm Types

	1	2	3	4	5	6
	Δ l(avgwage)	Δ emp	Δ sk_ratio	Δ sales/emp	Δ sales	Δoffshore
Existing	0.007	-0.035	0.019	0.000	-0.035	0.018***
Offshoring Firms	(0.009)	(0.036)	(0.017)	(0.038)	(0.046)	(0.006)
New Offshoring	0.036***	-0.134***	0.013	0.019	-0.116*	0.014***
Firms	(0.012)	(0.045)	(0.021)	(0.059)	(0.068)	(0.005)
Former Offshoring	0.002	-0.084	-0.008	-0.172	-0.255***	0.022**
Firms	(0.022)	(0.106)	(0.040)	(0.133)	(0.096)	(0.01)
N	1293	1293	1293	1293	1293	1293

Note: Robust standard error in the parenthesis. ***,**,* indicate significance at 1,5,10 percent levels respectively.

Table 10: Worker Level Wage Regression

	age	age^2	experience	$experience^2$	high_sk	med_sk
log wage	0.041***	-.0003***	0.010***	-0.0003***	0.460***	0.395***
	(0.0004)	(0.000)	(.0003)	(0.000)	(.0106)	(.007)

Note: Standard errors in parenthesis estimated with 50 bootstrap replications, clustering at level of individuals. The regression includes time fixed effects. ***,**,* indicate significance at 1,5,10 percent levels respectively. Number of observations 1106744.

Table 11: Difference-in-difference Estimate Using Measures Constructed from Worker Level Wage Regression (2002-2005)

	1	2	3
	Δ avg(lwage)	Δ sk_comp	Δ rent_sh
Offshoring in 2002	0.012**	0.003*	0.009**
	(0.005)	(0.002)	(0.004)
N	1742	1742	1742

Note: Robust standard errors in the parenthesis. All regression includes industry fixed effects. **,**,* indicate significance at 1,5,10 percent levels respectively.

Table 12: Triple Difference Estimate Using Measures Constructed from Worker Level Wage Regression by Firm Types

	1	2	3
	Δ avg(lwage)	Δ sk_comp	Δ rent_sh
Existing Offshoring	0.012*	0.008*	0.005
Firms	(0.007)	(0.004)	(0.008)
New Offshoring	0.018*	0.001	0.017*
Firms	(0.01)	(0.005)	(0.01)
Former Offshoring	-0.027	-0.019	-0.008
Firms	(0.024)	(0.02)	(0.015)
N	1272	1272	1272

Note: Robust standard error in the parenthesis. ***,**,* indicate significance at 1,5,10 percent levels respectively.

Table 13: Difference-in-Difference Estimate Using Alternate Firm Types (2002-2005)

	1	2	3
	Δ avg(lwage)	Δ sk_comp	Δ rent_sh
Offshoring in 2002	0.013**	0.005*	0.008*
	(0.005)	(0.003)	(0.004)
Offshoring after 2002	0.011*	0.002	0.009*
	(0.007)	(0.004)	(0.006)
N	1742	1742	1742

Note: Robust standard error in the parenthesis. All regression includes industry fixed effects. ***,**,* indicate significance at 1,5,10 percent levels respectively.

Table 14: Triple Difference Estimate Using Alternate Firm Types

	1	2	3
	Δ avg(lwage)	Δ sk_comp	Δ rent_sh
Offshoring in 2002	0.016**	0.007**	0.009*
	(0.007)	(0.004)	(0.006)
Offshoring after 2002	0.017*	0.009*	0.008
	(0.010)	(0.005)	(0.009)
N	1483	1483	1483

Note: Robust standard error in the parenthesis. ***,**,* indicate significance at 1,5,10 percent levels respectively.

Table 15: Difference-in-Difference Estimate Using Manufacturing and Non-Manufacturing Firms (2002-2005)

	1	2	3
	Δ avg(lwage)	Δ sk_comp	Δ rent_sh
Offshoring in 2002	0.018***	0.005*	0.013***
	(0.004)	(0.003)	(0.004)
N	6253	6253	6253

Note: Robust standard error in the parenthesis. All regression includes industry fixed effects. ***,**,* indicate significance at 1,5,10 percent levels respectively.

Table 16: Triple Difference Estimate Using Manufacturing and Non-Manufacturing Firm

	1	2	3
	Δ avg(lwage)	Δ sk_comp	Δ rent_sh
Existing Offshoring	0.01*	0.012**	-0.002
Firms	(0.006)	(0.004)	(0.005)
New Offshoring	0.02**	0.012*	0.009
Firms	(0.01)	(0.007)	(0.08)
Former Offshoring	-0.026*	-0.013	-0.013
Firms	(0.013)	(0.012)	(0.013)
N	6808	6808	6808

Note: Robust standard error in the parenthesis. ***,**,* indicate significance at 1,5,10 percent levels respectively

Table 17: Firm share of imports coming from China (CN) between 1999 and 2005

	No. of firms*	**1999**	**2001**	**2002**	**2005**
Firms not present in CN in 2002	402	16%	10%		15%
Firms not present in CN in 2002 but not in 1999	294		5%	6%	13%
Firms present in CN in 2002	1803	16%	17%	15%	22%
Firms present in CN before, in, and after 2002	805	16%	20%	20%	26%
Firms present before 2002 and again in 2005	45	11%	4%		8%

* Based on 2002

Source: Statistic Denmark's firm level external trade statistics, own calculations

Table 18: Danish firms importing from China (CN) and the Czech Republic (CZ)

Number of manufacturing firms	**Imports from China..**		**Imports from CZ..**	
	..in total	**..and not CZ**	**..in total**	**..and not CN**
Importers in 2002	3995	3391	1637	287
Importers in 2005	7033	6539	872	98
Not importing from either two in 2002	3015		3015	
New to import from source	3038	580	-765	14

Source: Statistic Denmark's firm level external trade statistics, own calculations

Table 19: Using 2002-2004 as the shock period (triple difference estimates comparable with the main results of Table 12)

	Δ avg(lwage)	Δ sk_comp	Δ rent_sh
Existing Offshoring	0.014*	0.006	0.008
Firms	(0.007)	(0.004)	(0.007)
New Offshoring	0.0192*	0.001	0.018*
Firms	(0.01)	(0.005)	(0.09)
Former Offshoring	-0.027	-0.015	-0.005
Firms	(0.024)	(0.02)	(0.016)
N	1360	1360	1360

Note: Robust standard error in the parenthesis. ***,**,* indicate significance at 1,5,10 percent levels respectively.

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Chapter 3

Exporter Price Response to Exchange Rate Changes

BY

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Abstract: Firms exporting to foreign markets face a particular challenge: to price their exports in a foreign market when the exchange rate changes. This paper takes on pricing-to-market using a unique data set that covers firm level monthly trade at great detail. As opposed to annual trade flows, monthly trade flows bring us closer to the transaction level where firm decisions are actually made. I find that the utilization of monthly data does add new information about the average level of pricing-to-market, and the differences between long-run pricing-to-market and short-run pricing-to-market. Furthermore, I find industry differences in pricing-to-market in terms of the magnitude (zero to complete pricing-to-market) and the timing (when do firms changes prices), and that prcing-to-market is stronger on high-income markets. As discussed in detail in the paper, all results are in-line with predictions of several theoretical contributions to the litterature on pricing-to-market and exchange rate pass-through.

JEL Codes: F14, F31, L11
Keywords: Pricing-to-market, heterogeneous exporters, monthly firm level trade data

Acknowledgments: Special thanks to Pascalis Raimondos-Møller. Financial support from the Danish Social Science Research Council and data provided by the Centre for Economic and Business Research is gratefully acknowledged.

1. Introduction

Firms exporting to foreign markets face a particular challenge: to price their exports in a foreign market when the exchange rate changes. These export sales are influenced when the exchange rate changes and thus adjusting prices in response to these changes is crucial. If firms respond to fluctuations in foreign currencies by changing their export prices, we say that firms are pricing-to-market (PTM). Whether firms adjust prices or not, and by how much, depends on a range of circumstances, and in particular how competitive product markets are. The discussion of PTM relates to the long-standing literature on incomplete exchange rate pass-through[1] that is concerned with why import prices do not fully adjust to exchange rate changes.

This paper takes on PTM using a unique data set that covers firm level trade at great detail at monthly frequency. These high frequent data offer the opportunity of a new view on what hides behind the time-aggregate estimates typically found using annual data. Annual trade flows are the sum of multiple decisions taken at different points in time. By moving to monthly trade flows we get closer to the transaction level where firm decisions are actually made. To see the benefit of that, note that annual data provide annual unit values — called prices in this literature. By being annual data, these prices are averages over the different prices the firm has charged during that year. With quantity rebates being a popular pricing strategy (for recent evidence see e.g. Chu, Leslie & Sorensen, 2011), annual averages may indeed be far away from actual prices. Using monthly data, and thus monthly unit values, we can be almost sure that unit values are indeed close to the price specified in a particular export contract.

I find that the utilization of monthly data does add new information about average PTM, and the differences between long-run PTM (LRPTM)[2] and short-run PTM (SRPTM)[3]. Furthermore, I find industry differences in terms of the magnitude and the timing of PTM, and that PTM is stronger on high-income markets. As discussed in detail later on in the paper, these results are in-line with theoretical predictions of choice of invoice currency and the associated pricing mechanism.

My analysis is performed using the unique opportunity of matching the population of Danish firms from the FIDA panel from Statistics Denmark with monthly firm-product-destination level trade flows. I match the firm-level data with foreign exchange rate data from 27 non-euro

[1] The literature on exchange rate pass-through has been around for the past three decades. Goldberg & Knetter (1997), Campa & Goldberg (2005), and Gopinath & Itskhoki (2010) represent important papers from each decade.

[2] Defined as the sum of exchange rate impact from 12 monthly lags.

[3] Defined as impact from a significant single lag of the exchange rate.

countries that make up about half of all Danish manufacturing exports. The data allows me to estimate closely the link between high-frequency firm-level trade and the constantly changing exchange rate.[4] I estimate implied price elasticities to the exchange rate from a set of fixed effects (within) regressions.

Following Berman, Martin & Mayer (2012) this paper starts by estimating export price elasticities using annual data on Danish firms. These annual estimates are computed in order to later on contrast the estimates using the more frequent monthly data. Using this annual data I find that Danish exporters on average adjust local currency export prices by 1.4% following a 10% currency change (i.e. PTM is 14%). Such an elasticity resembles the one found in the French annual firm-product-destination-level data.[5] But what exactly does this annual PTM measure cover? Is it a time-averaged measure or a long-run effect? Following Campa & Goldberg (2005), I sort out the possible time-aggregation by comparing the annual estimates to different estimates from the monthly data: specifically LRPTM and SRPTM. I find that overall LRPTM in the manufacturing sector is 18%, thus evidence of higher PTM than the annual estimate suggest. From the estimation equation for the LRPTM[6], I restrict the estimation to as few lags possible in search of a short-run estimate for PTM. At the aggregate level I find that SRPTM prevails in the very short run and on average the value coincides with the LRPTM estimate. However, restricting the analyses to high-income destination markets points to higher SRPTM. Further exploring SRPTM and LRPTM within industries demonstrates that PTM varies considerably across industries in terms of magnitude and timing, and with large differences between SRPTM and LRPTM.

My results suggest that exporting firms respond to changes of exchange rates by swiftly adjusting their prices as pricing-to-maket considerations imply. As time passes and more information is available concerning competitors' pricing and market reactions, firms will reduce their initial adjustments, and thus the long-run response to exchange rate movements is lower than initial, short-run responses. Clearly, annual data are not in position to uncover such a pattern of responses. Having knowledge on how firms react to exchange rates changes both in the short and the long run is important when assessing exchange rate regimes and their implications for firm behaviour.

[4] In contrast, Campa & Goldberg (2005) use an OECD country-level panel.

[5] Best comparable measure from Berman, Martin & Mayer (2012) is in the range of 9.7-12.4%

[6] I follow the traditional definition (see Campa & Goldberg, 2005, and Gopinath & Itskhoki, 2010) as described in detail later on

The paper proceeds as follows: Section 2 discusses PTM and contributions to the PTM and pass-through literature. Section 3 presents the data. Section 4 presents the estimation methods. Section 5 presents the results, and section 6 concludes.

2. Exchange Rates and Trade

While estimation of PTM focuses on export prices, many studies have focused on import prices and to what extent they respond to exchange rate movements. This literature has documented the presence of incomplete exchange rate pass-through, i.e. that import prices do not fully adjust to exchange rate changes, and thus indirectly evidence of imperfect competition. The discussion in this section will also briefly concern exchange rate pass-through, because contributions to this literature and the finding of incomplete pass-through can be conceived as the mirror image of PTM. When discussing pricing to market I will refer to different elements of pricing-to-market, specifically short-run pricing-to-market (hereafter SRPTM) and long-run pricing-to-market (hereafter LRPTM). In the pass-through literature we also find an equivalent terminology.

The literature on exchange pass-through is well-covered and goes well back in time. Goldberg & Knetter (1997) document exchange rate pass-through on import prices of 60%.[7] Recently in the pass-through literature Gopinath & Itskhoki (2010) present and calibrate a model with price rigidities. The results suggests that long-run pass-through on import prices is much lower (20%) than the 60% Goldberg & Knetter (1997) suggested. Campa & Goldberg (2005) document differences in short-run and long-run exchange rate pass-though levels as well as differences across source countries. Though pass-through studies often offer great detail on the product side, they are commonly macro level studies limited to explore industry and country variation, and not firm-level based analyses.

The empirical literature on PTM from the perspective of the firm is vastly unexplored. Berman, Martin & Mayer (2012) are the first to explore the firm-level analysis of heterogeneous PTM. They provide estimates using French firm-level data and document the heterogeneity of export price elasticities with respect to exchange rate changes. They explain theoretically, and they are able to document, heterogeneity in PTM on the basis of productivity differences. Extending Melitz & Ottaviano (2008) to include exchange rates they consider product markets to

[7] Estimates vary considerably (e.g. 20-25% in Gopinath, Itskhoki & Rigobon, 2007). Other papers include: Knetter (1993), Lapham (1995), Feenstra et al (1996). Recent studies include Halpern & Koren (2007), Gopinath & Rigobon (2008), Gopinath, Itskhoki & Rigobon (2007), and Gopinath & Itskhoki (2010).

have decreasing price elasticities (a feature that e.g. linear demand satisfies)[8]. In this theoretical setting, high-productivity firms have lower prices compared to low-productivity firms. They therefore operate further down the demand curve and perceive demand elasticities for their products to be lower. If an exporter is exposed to a depreciation of its currency, its price in the foreign currency falls if the exporter does not react. This implies complete exchange rate pass-through. If the exporter perceives demand elasticities for its products to be low, then it can withhold some of the currency gain by increasing its price markup, thus increasing its home currency price. This is an act of PTM and implies incomplete exchange rate pass-through.

If entering into exporting involves fixed costs, we have endogenous selection into exporting, implying that observed exporting firms in the data per se are more productive than non-exporters (Melitz, 2003). Thus, from this selection story, we can expect that the average exporter exercises PTM (i.e. we can expect to find significant implied export price elasticities to exchange rates) because these exporters are fairly productive, otherwise they would not export. Moreover, if firms do perceive product price elasticities to be low, and also to be lower for more productive producers, we can expect above average PTM from the most productive exporters compared to the rest of the exporters. Indeed, while Berman, Martin & Mayer (2012) find evidence of PTM for the average exporter, they also find that less-than-average productive exporters engage less in PTM and that highly productive exporters engage more in PTM.

Performing a similar estimation of average PTM on Danish data shows that evidence of PTM exist among Danish Firms. So Danish firms that have succeeded in exporting, are to some extent competitive and have some level of market power. They can lower product prices less than one-to-one in response to exchange rate appreciations by not fully lowering export prices, and they can raise export prices somewhat in response to exchange rate depreciations and thereby not lower product prices one-to-one on the foreign market.

However, when we take theory to annual data and ultimately claim to test firm reactions, we must state clearly what we are trying to reveal. Annual average of the exchange rate takes out a great deal of variation. For example[9], for the US dollar against the Danish krone in the period 2004-2006 the three annual averages were within a range of 0.9% between the lowest and the highest of the averages. So virtually no observations on pricing to market should be made.

[8] Berman, Martin & Mayer (2011) also argue that Atkeson & Burnstein (2008) and a "firm-heterogeneity" extension Corsetti and Dedola's (2005) model with distribution costs can deliver such variable elasticities across firms.

[9] See Appendix B for more examples.

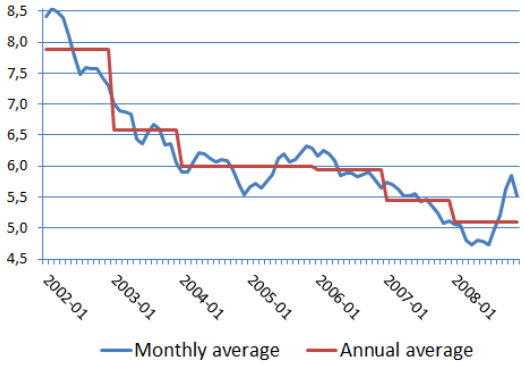

Figure 1: DKK per USD from JAN 2001 to DEC 2008

In this period, however, the monthly average fluctuates from 6% below the period average to 14% above the period average. Thus, several observations of considerable magnitude are left out in annual estimations compared to monthly, quarterly or even semi-annual data[10]. Thus, estimation of PTM using annual data does surely not represent a measure of SRPTM. This will also be clear from the results. PTM from annual data more resembles LRPTM, but at best we can consider the annual measure a time-average PTM measure biased towards LRPTM.

Low short-run and high long-run pass-through rates (or equivalently high SRPTM and low LRPTM) are documented empirically by Campa & Goldberg (2005) and theoretically by Drozd & Nosal (2012). Drozd & Nosal suggest a model in which sluggish market expansion in the short-run induces sellers to fight for market shares more fiercely than in the more flexible long-run where the market expands.[11]

Campa & Goldberg (2005) using a OECD macro-panel of commodity trade conclude that in the short-run the existence of partial pass-through rejects suggestions of both producer-currency-pricing (implying complete pass-through) and local-currency-pricing (zero pass-through). The choice of invoice currency is central in their argumentation. From a theoretical point of view they rely on Devereux & Engel (2001) and Bacchetta & Wincoop (2005) who suggest that monetary policy and exchange rate variability influences choice of invoice currency. If the monetary policy of a destination country is stable relative to the firm's own currency, and exchange rate variability is relatively low, then the invoice currency should be the one of your trading partner.[12] This

[10] See table A2 in the appendix.

[11] Fighting for market shares is also implied by Atkeson & Burstein's (2008) cournot type model.

[12] If country monetary policies are equally stable, one can also argue from a practical point of view that a firm wants to ensure that its products are as easily accessible as possible. It is a burden barrier and a burden for customers to translate foreign currency prices into their own currency and worry about risk.

reasoning implies that we can expect to see that pass-through on high-income markets is low (or equivalently PTM high) compared to mid- and lower-income markets, just because high-income countries are traditionally more stable from a monetary point of view.

With this overview in mind, we have multiple suggestions as to why the distinction between SRPTM and LRPTM is worth investigating, and why PTM is expected to be stronger on high-income markets. To investigate these issues, I rely on detailed, high-frequent export data from Denmark which are presented in the next section.

3. Data

I use the FIDA panel from Statistics Denmark. The data cover the universe of Danish firms from 1996 to 2008 and close to 100% of Denmark's external trade. The analysis takes place at the firm-product-destination-time level. I limit, however, the set of products per firm to only cover the best selling product at each destination at each point in time.[13] The panel consists of manufacturing firms exporting to non-euro countries that have more than 10 million DKK in export sales per year (about €1.4 million). The summary statistics of the annual and monthly data sets are presented in table 1. The resulting panel has 2,567 firms, 6,407 products and 653,604 observations (firm-product-country-time) between OCT 2001 and MAR 2008. General firm characteristics are annual but firm level external trade statistics are monthly. The trade statistics are destination specific and include 8-digit CN product classification, value, and units.[14] Thus, I compute unit values to proxy for free on board (FOB) export prices, as opposed to import prices that include cost, insurance and freight (CIF). Clearly, using export prices is less problematic than using import prices that contain elements that blur the pass-through picture and thus demanding usage of different controls.

[13] I have also computed a sample that only uses the firm's single best selling product throughout the sample period. Results are similar to those presented in the paper.

[14] CN is the Combined Nomenclature: The first six diggits are consistent with HS6, the last two are free of choice for the reporting country if the reporting country does not follow the European standard.

	Obs.	Mean	Median	Std.dev
Annual data (2002-2007)				
Full sample				
Firms				
# employees	1871	296	106	828
export share of revenue	7014	0,60	0,61	0,28
Exports				
log unit values	68050	5,00	4,81	1,97
log value of exports	68050	13,11	13,24	2,49
High-income country sample				
Firms				
# employees	1854	261	98	747
export share of revenue	6925	0,60	0,61	0,27
Exports				
log unit values	33040	4,94	4,74	1,92
log value of exports	33040	13,43	13,60	2,44
Monthly data (2001-2008)				
Full sample				
Firms				
# employees	2567	335	102	971
export share of revenue	11470	0,63	0,65	0,27
Exports				
log unit values	653604	5,05	4,86	2,02
log value of exports	653604	11,83	11,90	2,03
High-income country sample				
Firms				
# employees	2538	278	89	844
export share of revenue	11324	0,63	0,65	0,27
Exports				
log unit values	355961	4,99	4,79	1,99
log value of exports	355961	11,95	12,02	1,99

Source: Statistics Denmark, own calculations

Table 1: Firm level data descriptives

The 27 countries included in the data set are listed in appendix B. Among these countries are 14 major non-euro Danish export destinations[15] (see Table 2). Denmark participates in the European Exchange Rate Mechanism (ERM II) with a central rate of DKK 746.038 per €100. The system allows members to deviate by $\pm$15%, however, Denmark follows an agreement with the European Central Bank and the euro area members on a narrower fluctuation band of $\pm$2.25% (Danmarks Nationalbank). The analysis in this paper does not cover trade with the euro area.[16]

About half of Danish exports in 2006 was manufacturing exports. Half of that export went to non-euro destinations. Thus, non-euro exports made up about a quarter of Danish exports, constituting a cornerstone of Danish exports. If exporters indeed do react considerably to exchange rates, we have identified exchange rates as a likely source for short run aggregate export volatility that is not related to product market shocks.

[15] Constituting 44% of manufacturing exports (Statistics Denmark, see table 2)

[16] See figure B4 in the appendix for graphical inspection of the DKK-EUR relationship.

Country	DKR	EUR	Share
Germany	45.851	6.163	16.6
Great Britain*	23.986	3.224	8.7
Sweden*	23.355	3.139	8.4
USA*	22.196	2.983	8.0
France	12.885	1.732	4.7
Norway*	12.378	1.664	4.5
Netherlands	10.516	1.413	3.8
Italy	9.811	1.319	3.5
Spain	7.683	1.033	2.8
Japan*	7.547	1.014	2.7
Poland*	5.688	765	2.1
Rusia*	5.376	723	1.9
Finland	4.713	634	1.7
China*	4.163	560	1.5
Belgium	3.849	517	1.4
Ireland	3.634	488	1.3
Czech Rep*	3.523	474	1.3
Australia*	3.109	418	1.1
Switzerland*	2.640	355	1.0
Greece	2.580	347	0.9
Canada*	2.424	326	0.9
Austria	2.335	314	0.8
Korea*	2.306	310	0.8
Hungary*	1.520	204	0.5
Turkey*	1.502	202	0.5
Total Danish manufacturing trade	276.667	37.186	
Top 25 share of manufacturing trade			81.5
Non-euro share of manufacturing			46.12
Top 25 manufacturing share of total trade			50.87

Notes: In millions DKR and EUR. Non-euro countries are marked with a *
Source: Statistics Denmark

Table 2: Top 25 manufacturing export destinations

Compared to analyzing annualized data, this product detail at the monthly level brings us very close to the transaction level decisions. Matching this with monthly fluctuations in exchange rates, clearly brings us closer to a mapping between foreign exchange rates and product-destination-time specific pricing decisions.

Monthly foreign nominal exchange rates (NER) are from the Federal Reserve Bank of New York. Real exchange rates (RER) are CPI-deflated nominal rates. In the short run, fluctuations in the nominal exchange rate transfer to the real exchange rate. In the very short run (i.e. month-to-month) one can assume for country c that $\varepsilon_c = E_c \bar{P}_c$ where $\bar{P}_c$ is the fixed, relevant, relative price index between Denmark and country c, and ε is the real exchange rate. Thus a shock to the nominal exchange rate E changes the real exchange rate one-to-one and thus affects the decisions of the firm in (almost) the same way. The assumption that the real and the nominal exchange rates are highly correlated is consistent with empirical findings (see e.g. Kollman, 1997). In the results I primarily refer to estimations using the real exchange rate but

I also show results from the nominal exchange rate.[17]

Appendix B contains graphs of selected exchange rates. To ease the graphical comparison of exchange rates in appendix B, I clear unit differences in exchange rates by computing the demeaned exchange rate, $\widetilde{e_{ct}}$, between DKK and each foreign currency of country c at time t as $\widetilde{e_{ct}} = \frac{e_{ct}}{\overline{e_c}}$ where e_{ct} is the average exchange rate in month t, and $\overline{e_c}$ is the sample time average. I also use this demeaned exchange rate in the estimations, but it has no impact on the analyses. Exchange rates, e_{ct}, are denoted in foreign currency per Danish Krone. If e_{ct} increases by 10%, $\widetilde{e_{ct}}$ also increases by 10% constituting a 10% appreciation of the Danish Krone.

4. Estimation

I use two main estimation equations to estimate export price elasticities. Equation (1) is similar to Berman, Martin & Mayer (2012) and I use it for estimations involving annual data as well as monthly data:

$$\ln UV_{ijct} = \beta_0 + \gamma \ln \widetilde{e_{ct-l}} + \eta_t + \mu_{ijc} + \varepsilon_{ijct} \tag{1}$$

The dependent variable $\ln UV_{ijct}$ is log of the unit value, an approximation for FOB export prices. The explanatory exchange rate variable $\ln \widetilde{e_{c,t-l}}$ includes a certain lag of the exchange rate where $l = \{0, 1, .., 12)$ indicates either the lag in years or months[18] depending on the particular estimation carried out. The resulting estimates of γ are directly interpretable as implied price elasticities with respect to the exchange rate. Exchange rates are commonly[19] used as exogenous variation in firm-level studies for many purposes other than PTM and exchange rate pass-through, because exchange rate shocks are assumed to be orthogonal to other macroeconomic shocks that hit firms.

I use pooled OLS with dummies to capture fixed effects, so the estimate of γ is the dummy variable estimator (i.e. a fixed effects within-regression). The variable indices are firm (i), product (j), destination country (c), and time (t). I control for each year or month in the sample (η_t) and add firm-product-destination fixed effect (μ_{ijc}) to catch firm-specific effects for the individual firm's destination-specific product market. Industry fixed effect are not included

[17] For simplicity I refer to the exchange rate in the remaining part of this section without distiguishing between the nominal and the real exchange rate.

[18] Note that $l = 0$ in the estimations that use annual data because I use same-year-average exchange rate. In the estimations that use monthly data, I always use minimum one month lagged exchange rate.

[19] See fx. Greenaway, Kneller & Zhang (2008), Verhoogen (2008), Hummels, Jorgensen, Munch & Xiang (2010, on Danish annual firm-level data), and Brambilla, Lederman & Porto (2010)

as they introduce singularity.

From theory we know that an exporter practicing PTM will decrease its home currency price–in order to stay competitive in a foreign market–following an appreciation of its currency. So we expect $\gamma < 0$. If $\mid \gamma \mid < 1$ the exporter will lower the price by less than one-to-one, implying that the foreign importer will experience a rise, $dp_t^M = de_{c,t-l} \cdot (1 - \mid \gamma \mid)$, in the import price measured in the foreign currency at time t. The rise in the import price will thus a be lower percent increase than the the percent change in the exchange rate.

As discussed above, I wish to make the distinction between SRPTM and LRPTM. I can make this distinction using short-run data like monthly data. SRPTM tells us when and by how much an exporter changes its price in response to exchange rate fluctuation in the short run, while LRPTM tells us what the exporter's general pricing strategy is in response to trend movements of the exchange rate. I use a common definition of LRPTM[20], defined as the sum of the coefficients of the lags across time. The estimation equation is similar to the long-run exchange rate pass-through specification by Gopinath & Itskhoki (2010):[21]

$$\ln UV_{ijct} = \beta_0 + \sum_{l=1}^{12} (\gamma_l \cdot \ln \widetilde{e_{c,t-l}}) + \eta_t + \mu_{ijc} + \varepsilon_{ijct} \tag{2}$$

I use equation (2) in two different ways:
The first way is for estimating LRPTM, which is calculated as the sum of the coefficients $\sum_{l=1}^{12} \gamma_l$ for all 12 lags of the exchange rate. The second way is to estimate restricted versions by testing the exclusion of both single and multiple lags from the LRPTM-estimates. This I do in search of particular lagged responses for example within industries that may suggest differences across industries. Based on these restricted number of lags I then estimate SRPTM according to equation 1.

5. Results

This section first presents results from using the annual data to estimate average PTM in subsection 5.1. These estimates compare with estimates from French firm level studies using annual data and similar technique (Berman, Martin & Mayer, 2012). The estimates from the annual Danish data then serve as reference estimates of the level PTM, that the literature has

[20] See e.g. Gopinath & Itskhoki (2010) and Campa & Goldberg (2005).
[21] While they trail back two years of monthly lags, I stick to one year in this paper. The reason is the comparison with annual estimates.

so far been able to offer. Subsection 5.2 then presents results using the monthly data. That subsection will particularly highlight the information gained regarding differences in SRPTM and LRPTM.

5.1. Estimates of PTM Using Annual Data. Estimates by Berman, Martin & Mayer (2012) on French firm level annual data suggest that average PTM is low, around 10-12%. Column 1 in Table 3 presents average estimates of PTM using the Danish firm level annual data. Whether we use nominal exchange rates or real exchange rates has little impact on the estimate. The conclusion drawn is that using annual data, we find a bit higher base estimates of aggregate PTM on Danish firm level data compared to French data.[22] Judging from these annual estimates, Danish exporters lower export prices by 1.4% on average when facing an exchange rate appreciation of 10%. Columns 2-4 show estimates split on top level industry categories according to NACE classification Rev. 1.1. Clearly, the impression from these results is that the aggregate estimate in column 1 is the result of considerable variation across industries. Multiple explanations exists since firms in different industries face different challenges such as timing of production and differences in how to operate in the market,[23] or level of competition (possibly due to selection issues related to barriers of entering a market in the first place). Concrete examples will be discussed in section 5.2.

	(1)	(2)	(3)	(4)
Dependent variable	log unit value			
Nominal exchange rate (NER)				
log(NER)	-0,16 [c]	-0,13 [c]	-0,16	-0,19 [c]
	(0,07)	(0,06)	(0,11)	(0,09)
R^2	0,97	0,98	0,96	0,97
No. observations	68050	8858	39273	19919
Real exchange rate (RER)				
log(RER)	-0,14 [c]	-0,17 [c]	-0,09	-0,21 [a]
	(0,07)	(0,07)	(0,09)	(0,05)
R^2	0,97	0,98	0,96	0,97
No. observations	68050	8858	39273	19919
Sample (NACE industry category)	all	NACE = 1	NACE = 2	NACE = 3

Source: Statistics Denmark, firm level external trade statistics, own calculations
Notes: Industry classification according to NACE Rev. 1.1. See table A.1 for details.
Significance levels are 1, 5, 10 per cent (a,b,c)

Table 3: Pricing-to-market – annual data

[22] Note that estimates using Danish data are only significant at the 10 percent level. French estimates are more significant (see Berman, Martin & Mayer, 2012).

[23] For example off-the-shelf products such as socks compared to products produced after contracts are settled such as new turbines for a factory.

The extent of PTM also varies across markets. Singling out high-income destination markets, we see that PTM is particularly strong on high-income destination markets (see table 4, columns 3 and 4) compared to the full sample of export markets (columns 1 and 2). In other words: PTM on low-income markets pulls down average PTM estimates.[24] That PTM is stronger on high-income markets makes sense and is in-line with theories of more local-currency-pricing in the stable monetary high-income economies (see e.g. Engel & Devereux, 2001, and Bacchetta & Wincoop, 2005). On large and well-established markets[25] the presence of more varieties implies fiercer competition, and thus a firm must adjust prices to stay in the market in response to exchange rate movements (see Berman, Martin & Mayer, 2012, and Meltitz & Ottaviano, 2008).

	(1)	(2)	(3)	(4)
Dependent variable	log unit value			
log(exchange rate)	-0,16 [c]	-0,14 [c]	-0,25 [b]	-0,20 [b]
	(0,07)	(0,07)	(0,07)	(0,07)
R^2	0,97	0,97	0,97	0,97
No. observations	68050	68050	33040	33040
Sample (markets)	all	all	high income	high income
Exchange rate used	nominal	real	nominal	real

Source: Statistics Denmark, firm level external trade statistics, own calculations
Notes: Significance levels are 1, 5, 10 per cent (a,b,c).

Table 4: Pricing-to-market – annual data

We now turn to the use of monthly data to see what we gain from using monthly data compared to using annual data.

5.2. Estimates of PTM Using Monthly Data. The analysis of PTM using monthly data will be disaggregated in the following four ways: First, the time dimension by going from annual to monthly observations of firm level trade. Second, within-industry PTM estimates. Third, separate high-income markets[26] from the full sample. Fourth and finally, separate SRPTM from LRPTM.

Because this paper stresses the comparison of PTM estimates from annual data and monthly data, I use up to twelve monthly lags of the exchange rate to investigate whether this dynamic approach adds valuable information compared to the annual, average exchange rate used to find

[24] In fact, for some low-income countries individually, PTM results are inconclusive.

[25] The term is used loosely here. This could be a large economy such as Great Britain or an advanced but poorer economy like Korea, but it could also be a smaller economy with strong purchasing power, such as Norway, Sweden or New Zeeland.

[26] See table A.1 in the appendix. 78% of full sample trade flows are preserved in the restricted sample of high-income markets.

annual estimates. This approach finds support in Campa & Goldberg (2005).[27] Adding all twelve coefficients gives an estimate of LRPTM.[28]

Aggregate results and market type distinction. I start the analysis of the short-run data by estimating industry-aggregate LRPTM for all markets and for high-income markets. I then test the exclusion of all lags, but the first, jointly. They are all accepted, and I then estimate SRPTM based on the first lag only.

	(1)	(2)	(3)	(4)
Dependent variable	log unit value			
log(exchange rate$_{-1}$)	-0,18 [a] (0,02)	-0,18 [a] (0,02)	-0,31 [a] (0,02)	-0,29 [a] (0,03)
LRPTM	-0,17	-0,18	-0,28	-0,26
R^2	0,91	0,91	0,92	0,92
No. observations	653604	653604	355961	355961
Sample (markets)	all	all	high income	high income
Exchange rate used	nominal	real	nominal	real

Source: Statistics Denmark, firm level external trade statistics, own calculations
Notes: Significance levels are 1, 5, 10 per cent (a,b,c). LRPTM is the sum of the coefficients of exchange rates in t-1, t-2,.., t-12, thus trailing back the cummulated exchange rate response one year. All LRPTM-regressions pass joint significance tests of the coeffecients.

Table 5: Long Run Pricing-to-market – monthly data

Table 5 compares estimates of LRPTM and the first, single, monthly lag using both the nominal and the real exchange rate as explanatory variables. Not surprisingly at this level of frequency, PTM estimates using the nominal exchange rate and the real exchange rate, respectively, are similar. Focusing on the short-run estimate[29] based on the real exchange rate suggests that average PTM is higher than annual estimates suggest. Furthermore, at this industry-aggregate level, the short-run and long-run estimates coincide for the whole sample. For high-income markets a small difference appears, however I cannot tell whether the difference is significant.

Comparing the overall estimates (columns 1 and 2) with the estimates from high-income markets (columns 3 and 4) in table 5, we see that PTM is much stronger in high-income markets with LRPTM at 26% or higher, and SRPTM at 29% and higher. This is consistent with Drozd & Nosal's (2012) reciprocal prediction of lower short-run than long-run pass-through onto import

[27] They add up to four lags of the exchange rate in their analysis that uses quarterly data.
[28] I have also tried adding up to 24 for lags, just as Gopinath & Itskhoki (2010) do when determining Long-Run-Pass-Through. This does not add value to the determination of LRPTM.
[29] By picking the first lag as a result of exclusion testing.

prices. Note also that the differences in estimates between those from high-income markets are higher when we use monthly data (26-29% for RER) compared to when we use annual data (20% for RER).[30]

Dependent variable		log unit value			log unit value					
Nace code	**NACE description**	**LRPTM**	**R^2**	**# Obs.**	**RER-lag**	**SRPTM**	**R^2**	**# obs.**	**# firms**	**# products**
15	Manufacture of food products and beverages	-0,22	0,92	34740	1	-0,19 [a] (0,04)	0,92	39639	270	1005
17	Manufacture of textiles	-0,05	0,87	10958	1	-0,26 [b] (0,12)	0,87	12502	93	580
21	Manufacture of pulp, paper and paper products	-0,12	0,90	7529	1	-0,11 (0,19)	0,90	8461	54	272
22	Publishing, printing and reproduction of recorded media	-0,16	0,88	4749	1	-1,09 [a] (0,34)	0,88	5160	61	187
24	Manufacture of chemicals and chemical products	-0,43	0,96	20061	1	-0,59 [a] (0,10)	0,96	22889	139	786
25	Manufacture of rubber and plastic products	-0,22	0,88	29436	3	-0,33 [a] (0,10)	0,88	29824	181	805
26	Manufacture of other non-metallic mineral products	0,09	0,96	6803	1	-0,26 [c] (0,14)	0,96	7828	65	442
27	Manufacture of basic metals	-0,21	0,92	6814	5	-0,13 (0,14)	0,92	6898	59	407
28	Manufacture of fabricated metal products, except machinery and equipment	0,00	0,86	32533	2	-0,03 (0,10)	0,86	37050	279	1253
29	Manufacture of machinery and equipment n.e.c.	-0,17	0,77	100264	11	-0,19 [a] (0,06)	0,78	105734	567	1938
30	Manufacture of office machinery and computers	-0,37	0,75	4345	4	-0,44 [c] (0,23)	0,75	4784	29	257
31	Manufacture of electrical machinery and apparatus n.e.c.	-0,13	0,85	18470	1	-0,11 (0,10)	0,85	21407	142	828
32	Manufacture of radio, television and communication equipment and apparatus	-0,69	0,86	11114	3	-1,12 [b] (0,51)	0,86	10722	83	491
33	Manufacture of medical, precision and optical instruments, watches and clocks	-0,06	0,84	34003	1	-0,38 [a] (0,09)	0,84	38877	167	849
34	Manufacture of motor vehicles, trailers and semi-trailers	-0,42	0,85	8012	1	-0,35 [c] (0,16)	0,85	9175	53	364
35	Manufacture of other transport equipment	-0,57	0,88	4915	1	-0,68 [c] (0,34)	0,88	5020	68	508
36	Manufacture of furniture; manufacturing n.e.c.	0,04	0,91	32210	1	-0,14 [b] (0,05)	0,91	36147	223	559
PTM (based on selected sectors above)										
	Mean (weighted)	-0,16				-0,27				
	Mean (unweighted)	-0,22				-0,38				
	Median	-0,17				-0,26				

Source: Statistics Denmark, firm level external trade statistics, own calculations
Note: Industry classification according to NACE Rev. 1.1. Weighted mean PTM is based on number of observations. LRPTM is the sum of the coefficients of exchange rates in t-1, t-2,.., t-12, thus trailing back the cummulated exchange rate response one year. All LRPTM-regressions pass joint significance tests of the coeffecients.

Table 6: Industry specific estimations of Pricing-to-market - using monthly data

Industry variation. So far I have shown that disaggregating the time-dimension of PTM estimates delivers higher PTM estimates than estimations from annual data. Furthermore, we also know that PTM is particularly pronounced on high-income markets.

I now decompose the estimates on two-digit NACE-level industries for high-income markets. Table 6 presents the resulting estimates of LRPTM and prevailing lags after restriction tests[31] as a measure of the extent of SRPTM. Certain sectors have been left out of the table. Common for these sectors is that the panel consists of either few firms, few observations, or both. The table reads as follows: The left hand side columns contain results from estimation of LRPTM within

[30] See column 4 of tables 4 and 5, respectively.
[31] Every SRPTM estimation is different. Most contain a single lag, others contain a restricted set of lags where one lag becomes significant.

each 2-digit nace industry code. The right hand side columns contain estimates of SRPTM. *RER-lag* gives the significant lag number (e.g. a "1" reads SRPTM prevails at the one month lag, "11" at the 11 months lag, etc.). In the column to the right of *RER-lag* one finds the associated value.

Three key points from table 6 are particularly interesting: First, SRPTM is higher than LRPTM supporting the theoretical framework Drozd & Nosal (2012) and in-line with the empirical results of Campa & Goldberg (2005)–both discussed earlier. Second, firms in most sectors respond to exchange rates in the very short run, but some react in the medium-/short-run (3-5 months) and in a single sector firms reacts well in advance of the shipping date and thus more discretionary. Third and final, PTM varies considerably across sectors - from zero to 69% in the long run, and from zero to complete PTM in the short-run.[32] These results in general suggest that average PTM is low in the long-run, about (15-20%) but the variation across sectors is quite wide. Of the estimations presented above, significant findings of industry level PTM cover 81% of all observations and 79% of all firms (implying that not all firms, but quite a significant share, price-to-market).

While average SRPTM is almost twice the size of LRPTM, the detailed picture is much more varying. In the sector *Manufacture of textiles* (Nace code 17), LRPTM is very low, 5%, but 1-month-SRPTM at 26% is seven times higher. This reflects a sector in which short-term settlements dominate conduct of business. In the sector *Manufacture of radio, television and communication equipment and apparatus* (Nace code 32) firms are active in LRPTM and 3-months-SRPTM. This indicates that firms settle contracts and payments with sellers at least three months in advance of the shipment. Firms in the sector *Manufacture of machinery and equipment n.e.c.* (Nace code 29) make price adjustments in response to the exchange rate well ahead of shipment. Evidence of SRPTM is weak and coincides with LRPTM. This makes sense. Firms in this sector produce heavy manufacturing equipment and production of such products are often made on specific orders and possibly tailored for the individual need of the customer, not on expected orders.

To sum up, the evidence from the estimations of PTM on the monthly firm level trade data suggest that a more accurate PTM measure compared to an annual estimate enhances the documentation of presence of PTM. Or equivalently: pass-through is lower than one can expect when estimating pass-through rates from annual data. We cannot rule out neither producer-

[32] Highest value is 112% which is close to (actually more than) a one-one reaction to the exchange rate.

currency-pricing (complete pass-through or zero PTM) nor local-currency-pricing (zero pass-through or complete PTM) as Campa & Goldberg (2005). Estimates vary across industries and these findings open up for further research on timing of production, negotiation of contracts and pricing strategies of firms in different industries.

6. Conclusion

Danish exporters price to market. Unlike other studies on pricing-to-market or exchange rate pass-through, I disaggregate the time-aggregate estimates that one gets from using annual data by making use of high-frequency firm-level export data. From this data I explore the heterogeneity across industries and market types as well as aspects of dynamic pricing-to-market. The resulting price elasticities to the exchange rate are based on information on the numerous short-run fluctuations that are aggregated away in the annual estimates.

Estimates in this paper show that the short-run average pricing-to-market in the manufacturing sector is 18%. This compares with 14% using annual data. In-line with theoretical predictions pricing-to-market is higher on high-income-markets: 22% in the long-run and 38% in the short-run (un-weighted averages). Across industries pricing-to-market varies from zero to unity, implying that both producer-currency-pricing and local-currency-pricing occur in specific industries. Also in-line with theoretical predictions, Pricing-to-market is remarkably higher in the short-run compared to the long-run, underlining the belief that sellers fight for market shares in the short-run but in the longer run the market will expand and pricing strategies based on exchange rate fluctuations become less important.

Appendix A: Descriptive tables

Countries	High-income markets	G7 (non-euro)
Australia	x	
Brazil		
Canada	x	x
China		
Czech Republic		
Great Britain	x	x
Hong Kong	x	
India		
Japan	x	x
Korea	x	
Malaysia		
Mexico		
New Zeeland	x	
Norway	x	
Poland		
Rusia		
Singapore	x	
Slovakia		
South Africa		
Sri Lanka		
Sweden	x	
Switzerland	x	
Taiwan		
Thailand		
Turkey		
USA	x	x
Venezuela		

Note: High-income markets are defined as having minimum 50% nominal GDP per capita relative to Denmark. Korea is also placed here arbitrarily due to membership of the OECD and the size of the economy. No non-high-income countries in the list are richer than Korea in nominal per capita GDP terms.
Source: World Bank

Table A1: The 27 countries/economic regions in the sample

	Absolute percentage change of DKK-USD exchange rate									
	10	9	8	7	6	5	4	3	2	1
Interval										
1 month							3	5	16	29
3 months		1	3	4	5	9	11	15	20	27
6 months	1	3	8	10	14	15	18	25	27	29

Source: New York Federal Reserve, own calculations

Table A2: Number of observed fluctuations in the DKK-USD exchange rate in 2004-2006

Appendix B: Graphical representation of exchange rates

All currencies in the graphs are in nominal exchange rates and are denoted in foreign currency per DKK. They are expressed in terms of units relative to the sample time average (i.e. they fluctuate around 1 over the time span of the sample). Monthly exchange rates are averages of daily averages. Annual rates are simple averages of monthly averages. Source: Federal Reserve Bank of NewYork.

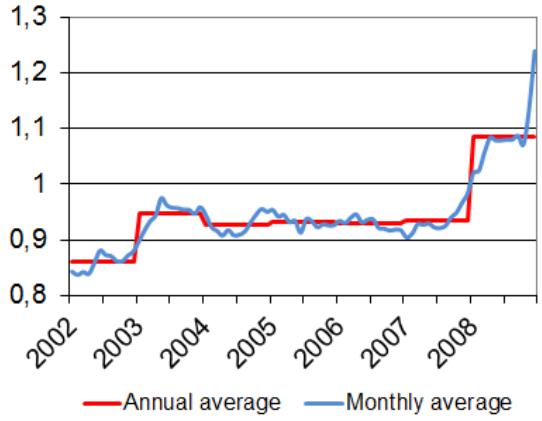

Figure C1: Great Britain

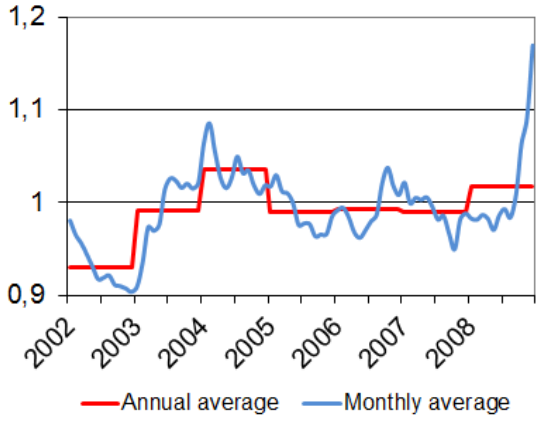

Figure C2: Norway

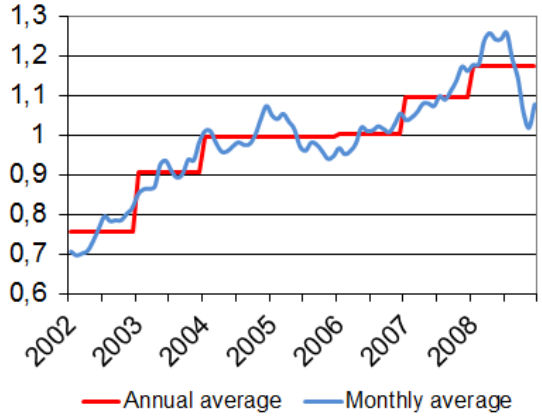

Figure C3: United States

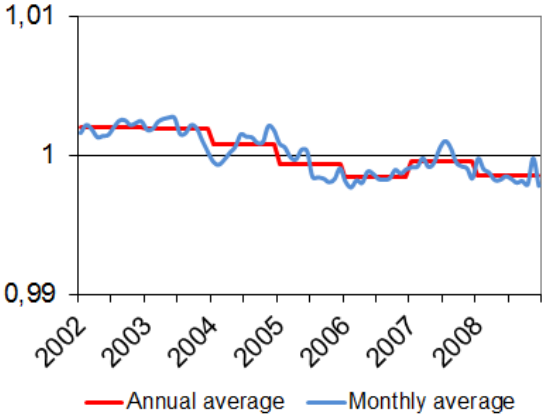

Figure C4: The Euro

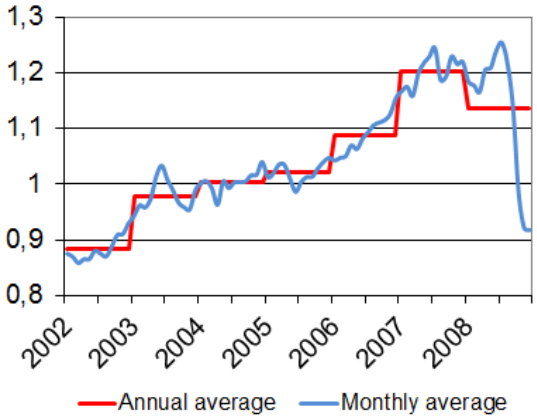

Figure C5: Japan

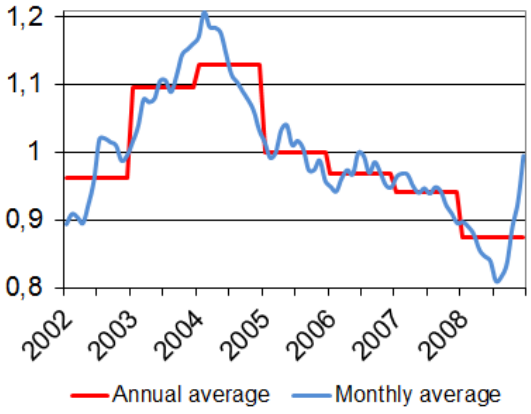

Figure C6: Poland

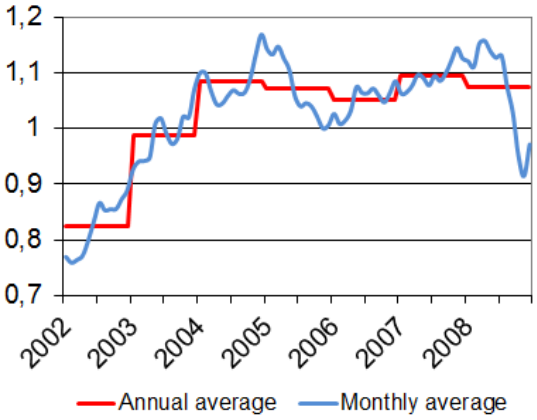

Figure C7: China

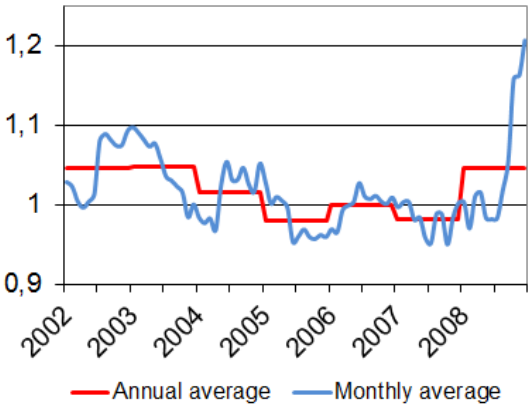

Figure C8: Austalia

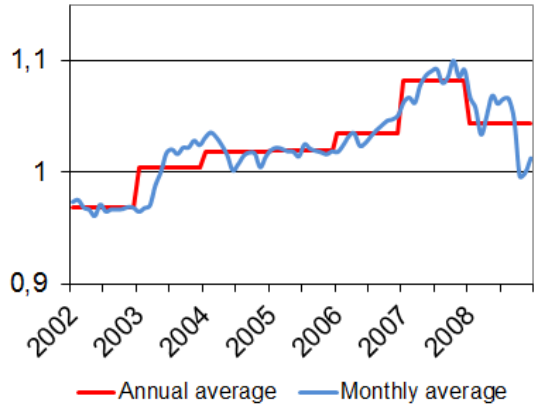

Figure C7: Switzerland

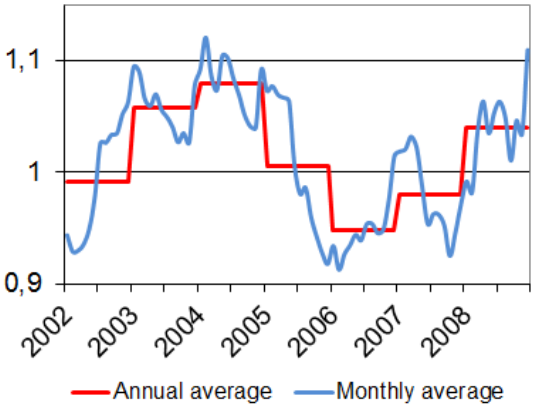

Figure C6: Canada

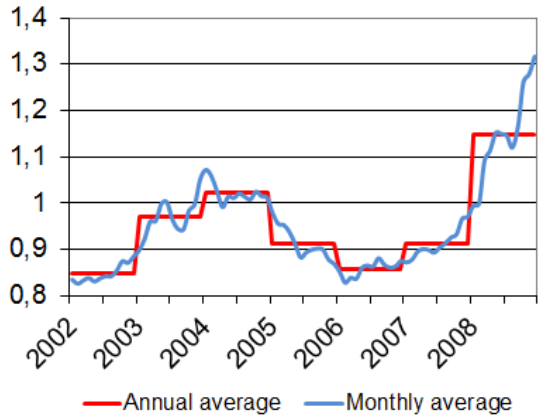

Figure C9: Rep. of Korea

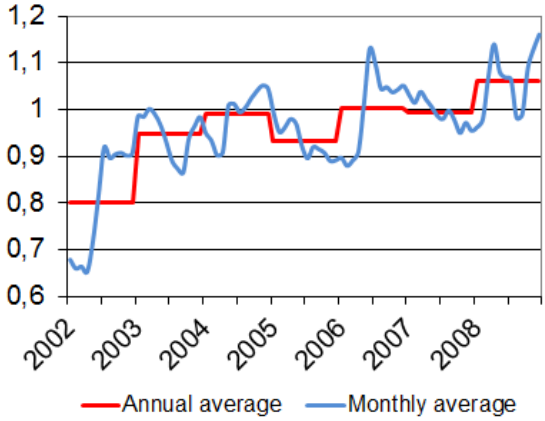

Figure C10: Turkey

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Conclusion

This thesis examines behavioral responses related to international trade.

The first chapter demonstrates the importance of modelling agents appropriately when estimating behavioral trade responses to tariff reforms. The second chapter utilizes worker-firm panel data to estimate firm wage responses to new offshoring opportunities, and demonstrates that firms act differently depending on their experience with offshoring to a new destinantion. The third chapter demonstrates that firms operating in different markets price very differently in response to exchange rate fluctuations, both in relation to magnitude of response and to the timing.

The first chapter highlight a general discussion on developing countries and exemplifies it through the use of Vietnam. Developing countries, especially socialist oriented developing countries, highly rely on state production. Indeed, Vietnam relies heavily on state industrial production. Such a predominant position of state-owned enterprises needs special consideration or otherwise mistaken policy conclusions can be made. The policy that this paper considers is the trade liberalization scheme that WTO has imposed on Vietnam upon its accession into the WTO in 2007. Tariffs have to fall in a pre-defined way by 2014. As we show, the ultimate gains from trade liberalization on economic development in Vietnam will be greatly at stake due to the distortions created by the strong presence of state-owned enterprises.

The WTO accession-led tariff reform does not take all this into account. Tariffs on state-owned produced goods fall, but not a lot — other sectors' tariffs fall even more. As a result, the WTO accession tariff cuts will worsen the situation for Vietnam with the state-owned sector expanding even more. There are also distributional consequences to be aware of. Our results show that the aggregate welfare loss will hit mostly the lower-income rural population. These are

the people that work in the sensitive labour-intensive primary sector. As generally recognized, this rural population is the prime source of poverty in developing countries, so the fact that the welfare losses are primarily within the lower end of the income scale demands special attention.

Policy makers must recognize that state-owned produced goods have to undergo relatively larger trade liberalization than competitively produced goods to secure the gains from trade. Therefore, not even other traditional tariff reforms (such as proportional tariff cuts and concertina cuts) will work in this setting. Such reforms will fail to reduce sufficiently the protection of the state-owned sector and thus bound to fail. Indeed, our calculations show that this is clearly the case.

Inspired by the basic principle behind the concertina tariff cut reform, viz. that we should reduce the highest distortion, we suggest a tariff reform that targets the highest distortion in the present model. We reduce the tariff of the state-owned enterprises leaving the other tariffs unchanged. To show the potential that such a reform can have, we search for the tariff level that will maximize the potential welfare gains. It turns out that the imports of the state-owned produced good should be subsidized by 32%. In that case, both the aggregate welfare and the welfare of the low income rural population will rise considerably.

Clearly, if Vietnam was able to complete within the accession period a reform of state-owned enterprises so that they become competitive, the WTO accession schedule of final rates, as all other conventional tariff reforms, will yield aggregate welfare gains. However, such a complete restructuring of the state-owned enterprises is far from what is going on in reality.

The second chapter uses rich linked worker-firm data from Denmark to address how offshoring affects firm level average wage. The chapter uses China's accession to the WTO in December 2001 and the boom in Chinese exports soon after, as an exogenous shock to the incentive to offshore to China by Danish firms. This shock allows identification of the causal effect of

offshoring on wages.

Unlike other papers in this literature, the chapter considers different possible channels– namely skill composition and rent sharing effects– to explain offshoring induced gains in firm average wages. A skill composition effect increases average wage if firms send low-skilled jobs abroad retaining high skilled workers at home who require higher pay. A rent sharing effect increases average wage if firms share offshoring induced increase in profits with all existing worker. The findings show that firms sourcing from China in 2002 had higher increase in average wages between 2002 and 2005 compared to the control group. While the presence of the skill composition effects does underline that Danish firms offshore certain jobs, the presence of the rent sharing effect highlights that firms offshoring to China also enjoy increased profitability and share that with employees. The important result to highlight here is that the timing of when a firm is exposed to a shock to the incentive to offshore matters. In our case: Firms present in China before China's accession to the WTO in December 2001 offshored jobs using relatively unskilled labor. Whereas, firms not present in China before the time of accession increased profitability and shared these increases with their employees, thus pointing to increased welfare. These firms however did not offshore relatively more any particular skill type of job. One possible explanation for this could be the size difference of the two types of firms and hence their workforce composition. Smaller manufacturing firms (less than thirty employees) are likely to have more homogeneous workforce and for them the average skill level of the workers might not change much over the years. Bigger firms already offshoring to China are likely to have more diverse workforce and hence for them both composition and rent sharing matter for the wage increase. However, the skill composition effect significantly explains about half that gain while the other half explained by the rent sharing effect is not statistically significant.

Though estimations are carried out at the firm level, the estimations fully utilize the worker-

firm matched data. Following Frias, Kaplan & Verhoogen (2012) effects on average wages are decomposed into estimated effects due to skill composition changes and changes due to rent sharing. These results are compared with results obtained using measures of skill composition and rent sharing available from typical firm level data. The chapter shows that using linked worker-firm data adds insight behind the wage increase mechanism because, in this case, the two sets of results do not conform; ratio of educated to uneducated workers as a traditional measure for skill composition and sales per employee as a measure of rent sharing cannot explain the average wage increase. Our measure of composition and rent sharing constructed from the worker level wage regression of the AKM type do.

The third chapter demonstrates that Danish exporters price to market. Unlike other studies on pricing-to-market or exchange rate pass-through, this study disaggregates the time-aggregate estimates that one gets from using annual data by making use of high-frequency firm-level export data. From this data the study explores the heterogeneity across industries and market types as well as aspects of dynamic pricing-to-market. The resulting price elasticities to the exchange rate are based on information on the numerous short-run fluctuations that are aggregated away in the annual estimates.

Estimates in this paper show that the short-run average pricing-to-market in the manufacturing sector is 18%. This compares with 14% using annual data. In-line with theoretical predictions pricing-to-market is higher on high-income-markets: 22% in the long-run and 38% in the short-run (un-weighted averages). Across industries pricing-to-market varies from zero to unity, implying that both producer-currency-pricing and local-currency-pricing occur in specific industries. Also in-line with theoretical predictions, Pricing-to-market is remarkably higher in the short-run compared to the long-run, underlining the belief that sellers fight for market shares in the short-run but in the longer run the market will expand and pricing strategies based on

exchange rate fluctuations become less important.

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